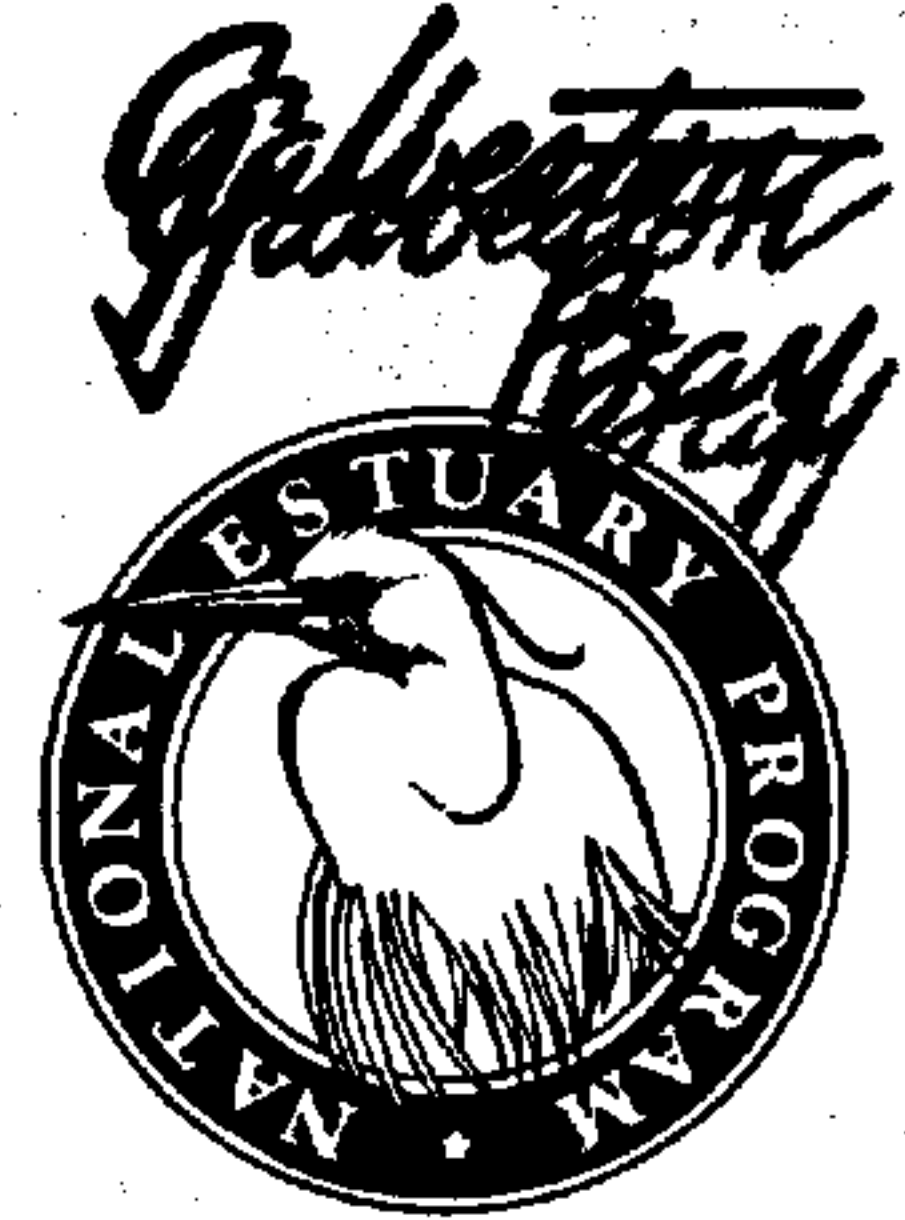


# Trawling Bycatch in the Galveston Bay System



Galveston Bay  
National Estuary Program

GBNEP-34  
August 1993

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# **Trawling Bycatch in the Galveston Bay System**

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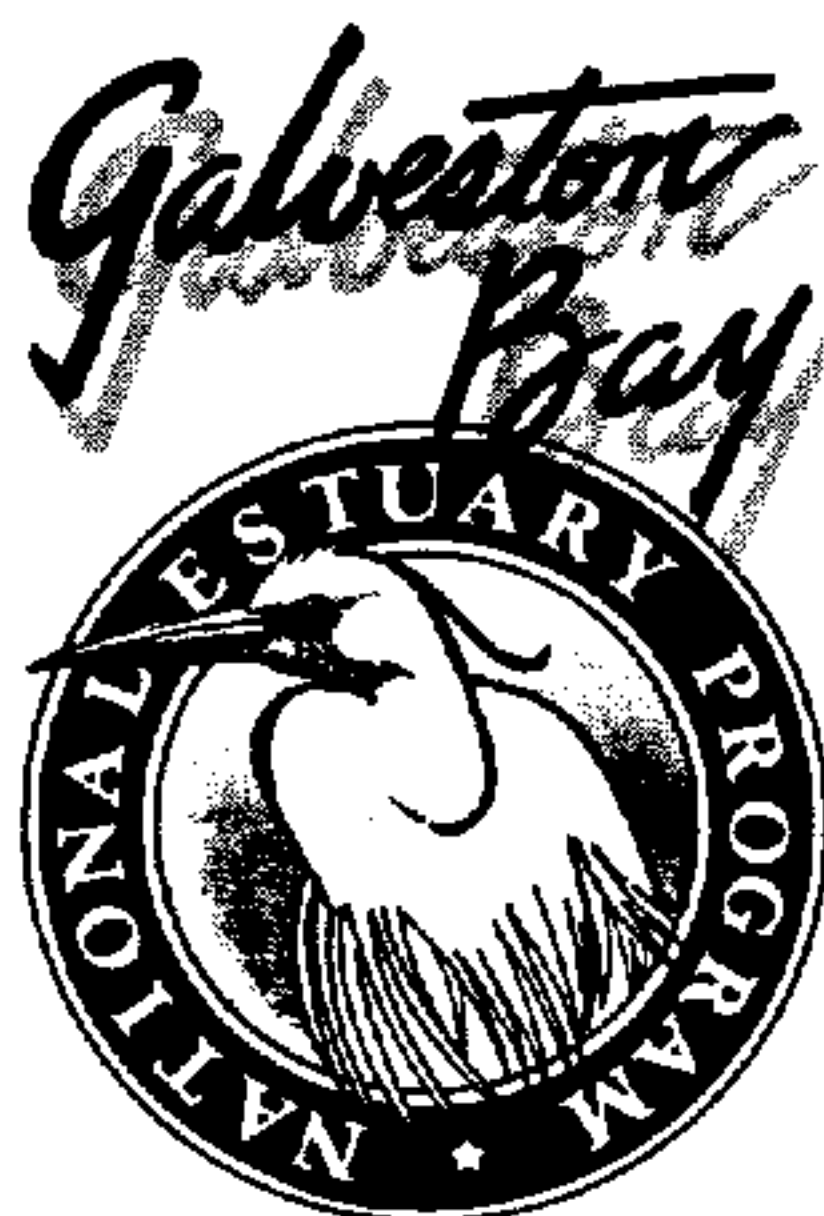
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**Publication GBNEP-34  
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## The Galveston Bay National Estuary Program

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Texans increasingly express their expectations for a clean environment in terms of entire ecosystems. Until recently, our tendency was to view environmental problems in isolated pieces we could understand—indeed this view was institutionalized (and seemingly immortalized) in an elaborate mosaic of fragmented jurisdictions. The Galveston Bay National Estuary Program (GBNEP) is a forerunner in elevating hands-on management of coastal environments to the level of the ecosystem; and in doing so, is encouraging an integration of traditionally disparate institutions.

The GBNEP was established under the authority of the Water Quality Act of 1987 to develop a *Comprehensive Conservation and Management Plan* (CCMP) for Galveston Bay. The purpose of the CCMP is to address threats to the Bay resulting from pollution, development, and overuse. To address these threats, five years of work commenced in 1990, consisting of three phases: (1) Identification of the specific problems facing the Bay; (2) A Bay-wide effort to compile data and information to describe status, trends, and probable causes related to the identified problems; and (3) Creation of the CCMP itself to enhance governance of the Bay at the ecosystem level. The GBNEP is accomplishing this work through a cooperative agreement between the U.S. EPA (Region 6) and the State of Texas (administered by the Texas Water Commission).

The structure of the GBNEP reflects a strong commitment to consensus-building among all Galveston Bay user groups, government agencies, and the public. The GBNEP "Management Conference" consists of six Governor-appointed committees with broad representation, totaling about one hundred individuals. Meetings of these committees are also open to the public, and public participation in policy-setting and in Bay management are considered strengths of the program. When submitted to the Governor of Texas in late 1994, the CCMP will reflect thousands of hours of involvement (much in the form of volunteer time) by individuals who in various ways use, enjoy, or help govern this vital coastal resource.



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# TRAWLING BYCATCH IN THE GALVESTON BAY SYSTEM

Eduardo X. Martinez, James M. Nance, Zoula P. Zein-Eldin,  
Jeffrey Davis, Lon Rathmell and Dennis Emiliani

## I. EXECUTIVE SUMMARY

The Galveston Bay National Estuary Program (GBNEP) commissioned an investigation to characterize shrimp trawl bycatch in the Galveston Bay system. The characterization study, performed by the National Marine Fisheries Service (NMFS) Galveston Laboratory, was conducted in three phases: 1) a review of historical bycatch studies, 2) initiation of new data collection efforts on commercial vessels and 3) a comparison of new data collected with fishery independent surveys of the Texas Parks and Wildlife Department (TPWD). Three historical studies regarding bycatch in Galveston Bay were identified and reviewed. Matlock (1982) analyzed the catch of gulf and southern flounder (*Paralichthys albigutta* and *P. lethostigma*, respectively<sup>1</sup>) in 34 tows from a commercial shrimp vessel during April-November 1978. He concluded bycatch of flounder was lower in Galveston Bay than in other Texas bay systems. Monthly averages ranged between 0 and 19.3 flounder caught per hour, with the overall average (April-November) for Galveston Bay being  $1.7 \pm 1.2$  (SE) flounder caught per hour. Lamkin (1984) reviewed bycatch in tows sampled from one bait shrimp vessel in lower and West Galveston Bay during July 1981-June 1982. He identified 56 bycatch species (52 finfish species) from 62 samples (34 trips); bycatch averaged 27.2% of total catch weight (range = 17-42%). Lamkin observed that five species accounted for ~71% of the bycatch by number and 65% of bycatch biomass. These species included Atlantic croaker, sand seatrout, blue crab, spot and gulf menhaden. Lamkin's conclusion of minimal bycatch among bait shrimpers may have been biased because only one vessel was used for data collection and the fisherman utilized an unconventional "bottomless" net during trawling operations. Bessette (1985) accompanied 6 different bait shrimpers throughout 5 areas of Galveston Bay during May-November 1984. In 107 tows sampled, Bessette identified 66 species of finfish and 8 invertebrates. Bycatch comprised 3-99% of total catch weight with an average of 65%. Overall, bycatch catch per unit effort (CPUE) was  $35.3 \pm 35.8$  (SD) kg/hr. Baywide, Bessette observed 4.1 kg of fish captured for each kg of shrimp landed. However, in West Bay, she observed 0.9 kg of fish captured per kg of shrimp landed. The fisherman utilized in West Bay during the Bessette study was the same one in Lamkin's (1984) study. Bessette observed that this fisherman had the lowest bycatch and highest shrimp CPUE among all shrimpers who participated in her study. Atlantic croaker, gulf menhaden, spot and sand

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<sup>1</sup> Common and scientific names for finfish, molluscs and crustaceans used in this report follow nomenclature guidelines set forth by the American Fisheries Society (Turgeon et al. 1988; Williams et al. 1988; Robins et al. 1991). Throughout the text, common names will be used to refer to individual species; for species where no common name is provided by AFS special publications, scientific names will also be provided to avoid confusion. A complete directory of the common and scientific names of individual species is provided in Appendix 1 for reference purposes.



seatrout were the dominant bycatch species in terms of numbers and biomass. In the Bessette study, 6 species accounted for 75% of the bycatch by number; 9 species accounted for 81% of the biomass. Blue crab was conspicuously absent from the most dominant species in the Bessette study, in contrast with those results reported by Lamkin (1984).

New data collection was initiated in 1992 by NMFS. Prior to collecting samples, an industry advisory panel was assembled for the purpose of reviewing and approving the sampling design and methods. The panel was composed of 3 members of the Galveston Bay shrimp industry who were also involved in addressing various other concerns relative to fisheries in Galveston Bay. The panel members also reviewed quarterly and final reports and assisted in enlisting fishermen to participate in this study.

For data collection and analysis purposes, Galveston Bay was divided into three fishing areas: 1) Trinity Bay, 2) upper Galveston and East bays and 3) lower Galveston and West bays. A pool of commercial and live-bait fishermen who volunteered to participate was assembled for each of the 3 fishing areas; vessels and sampling days were randomly selected for each area on a monthly basis. Vessel captains/owners were compensated (on a per sample basis, up to a predetermined maximum) for allowing observers to remove samples of shrimp and bycatch from each tow. Up to 11.5 kg of shrimp and bycatch were collected (per tow) by observers during normal trawling operations; intensity of new sampling efforts was patterned after historical levels of shrimping effort. Catch subsamples were iced and returned to the laboratory for processing.

Twenty-five vessel owners agreed to participate in 1992 sampling efforts and 19 vessels were utilized (based on random selection). Of these vessels, 10 operated primarily under a commercial bay license, 6 were primarily live-bait vessels and 3 others operated equally under both bay and bait licenses. A total of 296 samples were collected during March- November 1992 (Trinity Bay = 34, Upper/East bays = 171, Lower/West bays = 91). Tows sampled covered trawlable bottom throughout the Galveston Bay system except for the Galveston ship channel. Few samples were available from Trinity Bay due to low shrimp catches (and consequently, effort levels) which were attributed to freshwater conditions caused by high precipitation/freshwater inflow during the early portion of the year.

A total of 85 species of finfish and 49 invertebrates were identified in new sampling efforts. The greatest diversity of individual bycatch species was observed during June-July and in the upper bay area. The high level of species diversity for the upper bay fishing zone is possibly because the majority of new samples were collected from this area, thus a greater number of 'rare' or uncommon species were captured. Furthermore, the upper bay fishing zone is polyhaline (brackish) and is thus inhabited by more freshwater, brackish and marine species (compared with the oligohaline (freshwater) Trinity Bay and more euryhaline (marine) lower bay fishing zones).

Overall, bycatch species comprised 38% of the total number of individuals captured and averaged 71% of total catch weight (range = 2-98%). Nine species (of 134 total) accounted for 80% of the bycatch by number and 79% by weight. These included gulf menhaden, Atlantic croaker, spot, cutlassfish, sand seatrout, bay anchovy, Atlantic



brief squid, hardhead catfish and blue crab. Invertebrate bycatch species were primarily composed of crabs, roughback shrimp, mantis shrimp, various jellyfish and mollusks.

CPUE data for shrimp and bycatch species were extremely variable with respect to time and area fished. Shrimp outnumbered finfish during May-November; shrimp outnumbered other invertebrates during April-November. The overall ratio of the number of finfish to shrimp caught was 0.53 to 1. Greater numbers of finfish were captured during March-April, a period prior to recruitment of brown shrimp into the Galveston Bay fishery. During March-November, finfish biomass (kg) was greater than shrimp landings by a ratio of 2.64 to 1 (monthly range = 1.04 - 32.78). Ratio of fish to shrimp biomass was also highest during March and April, prior to brown shrimp recruitment into the fishery. Ratios of invertebrates to shrimp captured were 0.09 to 1 (numerically) and 0.39 to 1 (biomass). Life histories of individual finfish and invertebrate species (as well as those of brown and white shrimp) are important in regulating bycatch ratios throughout the year. Migration of fish into and out of the estuary during specific months may also coincide with peak periods of shrimp recruitment. Ratios of finfish and invertebrates to shrimp were compared with 1992 landings to estimate the magnitude of total bycatch in the Galveston Bay system. Annual finfish bycatch is estimated at 3.7 million kg (monthly mean  $\pm$  SD is  $456 \pm 320$  thousand kg) and annual invertebrate bycatch is estimated 548 thousand kg (monthly  $X \pm$  SD is  $80 \pm 104$  thousand kg).

Several species which could not be utilized in analyses included alligator gar, crevalle jack, large sharks, stingrays, black drum, cutlassfish, southern flounder; also observed were butterflyfish (a reef species), tripletail (generally associated with *Sargassum* rafts and other flotsam in marine waters) and cormorants (waterfowl). These species were recorded as being present in trawls (field observations) but may or may not have been represented in subsamples which were processed in the laboratory. Consequently, reported CPUE values for these species may be underestimated. Overall, debris items ranked 15th in terms of total catch weight. Presence of spotted seatrout and southern flounder were among those species observed in freshwater conditions in Trinity Bay during early 1992.

Gulf menhaden, Atlantic croaker and sand seatrout were the only species of commercial or recreational value which were captured in great numbers. These species were also reported as the dominant species in two of the historical studies reviewed. However, it appears that fewer blue crab and more cutlassfish and hardhead catfish were observed during 1992 than in previous studies. All other recreational species (spotted seatrout, southern flounder, red drum, etc.) were captured relatively infrequently. Magnitude and composition of bycatch depends on numerous ecological factors, fishing gear and fishing methods. Additional analyses are required to determine the importance of factors such as tow speed and duration, gear differences, hydrology and climatic conditions.

A comparison of 1992 bycatch observations with TPWD fishery independent surveys indicates frequency, magnitude, and composition of bycatch are comparable for individual species during some months and not for others. Significant differences were found among length-frequency distributions for each species in one or more months. Furthermore, significant differences in CPUE (TPWD vs. NMFS data) are also

observed for each species in one or more months. Consequently, data from the TPWD fishery independent surveys may only provide an indication of baywide bycatch on a case by case basis (month by month, for certain species). However, mesh size in TPWD survey nets is smaller than that found in commercial fishing gear, thus affecting the comparability of analyses.

1992 sampling efforts addressed only the magnitude and composition of bycatch observed in trawls. Data were highly variable and continued characterization efforts would greatly enhance the estimation of magnitude and composition of bycatch species. In addition, bycatch mortality was not specifically examined in this investigation, thus mortality estimates cannot be calculated from these data. Mortality of individual bycatch species is likely affected by a wide variety of factors and merits further investigation. Other studies addressing bycatch should consider the role of bycatch in ecological nutrient cycles and niches, predator-prey/competition interactions of individual species and stock assessment of individual species to determine the proportion of bycatch species relative to individual baywide (or gulfwide) populations.



## II. INTRODUCTION

The Galveston Bay National Estuary Program (GBNEP) is presently developing a Comprehensive Conservation and Management Plan (CCMP) for Galveston Bay. The focus of the CCMP is to develop solutions with respect to problems and interactions among various groups which utilize or benefit from the Galveston Bay estuary system. Consequently, GBNEP has contracted numerous individuals and organizations to initiate investigations which are aimed at characterizing the physical, chemical, geological, ecological and biological aspects of Galveston Bay. Since the bay supports extensive commercial shrimp and bait shrimp industries, capture of bycatch species during trawling operations may have an impact on individual populations. Bycatch is non-target species (finfish and invertebrates) caught during shrimp trawling; it includes non-target organisms kept or discarded by fisherman as well as target species that are not retained. Thus, analysis of bycatch in the shrimp fishery is essential to the Galveston Bay characterization program; ultimately it will contribute to development of the CCMP.

Two agencies in Texas most involved with addressing impacts of bycatch are the Texas Parks and Wildlife Department (TPWD) within state waters, and the National Marine Fisheries Service (NMFS) in the Exclusive Economic Zone (EEZ). Until recently, neither agency had thoroughly addressed the magnitude and effects of bycatch of the bay shrimp fleet, although both agencies have monitored the fisheries within Galveston Bay for many years. TPWD has evaluated abundance of fishes and invertebrates in state bays since 1975 because fish and shellfish abundance are useful indicators of the biological status of the bay (Hegen 1983). These abundance estimates employ a fishery-independent, random sampling plan. Since the late 1950's, NMFS has monitored landings from the commercial shrimp fleet (Klima 1980) and the live bait shrimp industry (Baxter et al. 1988).

NMFS was contracted to characterize bycatch from the shrimp fisheries in Galveston Bay during the 1992 fishing season. The characterization of bycatch within the Galveston Bay system presented in this report is based on three primary objectives: 1) a review of historical bycatch studies within Galveston Bay, 2) initiation of new, comprehensive sampling efforts to characterize abundance and distribution of bycatch species in shrimp trawling operations throughout Galveston Bay, and 3) an attempt to link data from new sampling efforts with data collected during TPWD fishery independent surveys. The latter may provide an index or tool allowing future projections of bycatch magnitude based on data from the TPWD annual fishery-independent surveys. All data presented in this report are standardized for net length and tow duration (CPUE; catch per unit effort).



### III. REVIEW OF HISTORICAL BYCATCH STUDIES IN GALVESTON BAY

Historical information on bycatch in Galveston Bay is limited to several studies conducted during the 1980's. Matlock (1982) conducted a study of flounder bycatch from bay commercial and bait shrimpers. Lamkin (1984) monitored shrimp and bycatch on a single bait shrimp vessel in lower Galveston and West Bays over an eight month period. Bessette (1985) conducted a similar study on six bait shrimp vessels throughout the Galveston Bay system. Of the three studies, the bycatch data collected by Bessette (1985) is more extensive and recent. Additionally, some of the data collected by Bessette (1985) was available to us for review and analysis. Consequently, this historical review primarily focuses on the results of the Bessette (1985) study which are presented first. The Matlock (1982) study was limited to several species of flounder and is therefore discussed last in this review.

### METHODS

#### *Bessette Study*

Bessette (1985) accompanied six commercial Galveston Bay bait fishermen during May through November 1984. Each shrimper fished one of the major subdivisions of Galveston Bay defined in 1956 by the NMFS Statistical Office. Thus, she evaluated bycatch from six sites (Trinity Bay, Upper and Lower Galveston Bays, East Bay and two areas within West Bay; Figure 1), during the prime bait shrimping season. The fishery-dependent sampling design required biweekly sampling of each area, but weather and economics (demand for bait, etc.) sometimes hindered data collection. Bessette recorded total catch weight, shrimp weight, bycatch weight and duration (minutes) for each tow. Environmental data such as water temperature and salinity were recorded every third tow. To eliminate effects of variability in tow duration, catch per unit effort (CPUE, kg/hr) for shrimp, finfish and invertebrate catch was calculated on a per tow basis. Bessette also evaluated species composition of the bycatch, taking a random 4.5 kg subsample for species identification about every third tow. Samples from 107 of the total 355 tows were available for species identification. Total number of tows for species identifications in each bay area varied between 16 and 21. All surveyed shrimpers used some type of otter trawl; a fisherman who fished in the West Bay area, used a 'bottomless' otter trawl net (described later). Finfish:shrimp ratios were later computed from the original data, transformed to natural logs, and analyzed by either contrast comparison between sampling areas using general linear model (GLM) procedures or by simple linear regression between some of the variables (SAS Institute 1985; Zein-Eldin and Bessette, in prep).

### *Lamkin Study*

Lamkin (1984) limited his year-long investigation (July-December 1981, May-June 1982) to a single bait shrimper who fished only the eastern portion of West Bay, Offats Bayou, and, to a very limited extent, Lower Galveston Bay. Lamkin details the fishing gear (which includes a 'bottomless net') and fishing procedures without explicitly stating either sampling frequency or sampling design. However, the study was necessarily fishery dependent. Lamkin's data (Table 1) imply he accompanied the shrimper on 34 days; 28 between July 4 and December 31, 1981, and an additional 6 days between May and June 1982. Shrimp catch (both table shrimp and smaller bait shrimp) was estimated in quarts for each trawl on a sampling day. Total incidental catch from at least one trawl per day was weighed, preserved for later specific identification, and the ratio of shrimp:finfish was calculated (not finfish:shrimp as in Zein-Eldin and Bessette, in prep.). A total of 62 trawls was included in this portion of the research. Ratios were transformed (natural logs), and a monthly mean ratio with 95% confidence limits was calculated. A similar procedure was followed for shrimp:invertebrate ratios; only 55 trawls were included (perhaps because of the absence of invertebrates from some samples, but this is not stated). It appears biomass of shrimp and bycatch from the 62 special samples were totaled to derive the monthly percentage of total catch attributable to bycatch (Table 2).

The fisherman's monthly shrimp catch, days fished, and mean catch (kg/hr) were obtained from log books submitted to the NMFS bait shrimp program. Baywide bait catch and effort data were obtained from the NMFS Galveston Laboratory.

Lamkin detailed monthly bycatch, both in number and biomass for dominant species. The study also provided standard length frequency data for Atlantic croaker, sand seatrout, and spot, as well as carapace widths for blue crab, but these data were not discussed.

### *Matlock Study*

One randomly selected commercial shrimp trawler was accompanied one day each month from April through November 1978 in some area of Galveston Bay (Matlock 1982; Table 3). All flatfish were identified to species, and southern and gulf flounder were counted and measured (TL). Number of drags and tow duration were recorded. Mean catch rate (number/hr) was calculated for each month for the Galveston Bay system.

## **RESULTS AND DISCUSSION**

### *Bessette Study*

Hydrology: A salinity gradient was observed from Trinity Bay through the eastern portion of West Bay (Figure 2). Salinities, ranging from <1 to 30 ppt, followed similar seasonal patterns within all bay areas. Values were lower in May and June,



increased in July, August, and September, and decreased in early October. Mean salinity varied significantly ( $p > 0.0001$ ) among bay areas. The highest mean salinity (24.2 ppt) was recorded in eastern West Bay, the lowest (11.3 ppt) in Trinity Bay. No values above 17.0 ppt were recorded in Trinity Bay and salinities less than 1 ppt were observed in November 1984, a month in which mean salinity at the Galveston Pleasure Pier was about 12 ppt (17 ppt below the monthly long-term average; Pechmann et al. 1985). Surface water temperatures ranged from 14.0° C in November to 32.6° C in June, reflecting typical seasonal patterns. Over 75% of the tows were made at temperatures between 25.3 and 30.4° C, with temperatures above 30° C in each of the summer months (June-August). Water temperature decreased below 23° C in early November and was less than 20° C for the remainder of the sampling period.

Bycatch: Over the 355 tows and 221.5 hours of shrimping effort, bycatch weight averaged 65% (2.9 % to 98.8% in individual tows) of the total catch per tow, with mean baywide bycatch CPUE of  $35.3 \pm 35.80$  (SD) kg/hr and mean shrimp catch of  $15.3 \pm 21.48$  kg/hr. Baywide ratios (based on weight) of bycatch:shrimp averaged  $4.1 \pm 7.0$ . West Bay, near the Galveston causeway, was a notable exception (Figure 3). In West Bay, mean bycatch was significantly less than that of all other sampled areas combined, both as percent of total catch (mean  $31.1 \pm 23.8$  % vs.  $70.6 \pm 16.8$  %) and as CPUE (mean CPUE  $14.7 \pm 9.9$  kg/hr vs.  $35.3 \pm 35.80$  kg/hr). Finfish:shrimp ratio of one West Bay fisherman was  $0.9 \pm 2.02$  (Zein-Eldin and Bessette, in prep.). Data from this fisherman will be discussed separately in a later section and compared to data of Lamkin (from the same individual and fishing area).

Bessette identified 66 fish and 8 invertebrate species from the 37,166 individuals collected in the random samples of bycatch (Table 4). Of the 66 fish species, 8 were present in more than half the sampled tows. Only Atlantic croaker was present in all 107 tows (about one-third of all tows completed). Spot were present in 105 tows, gulf menhaden in 99 tows, sand seatrout in 92 tows, least puffer in 63 tows, pinfish in 61 tows, threadfin shad in 58 tows, and bay whiff in 57 tows; 11 other species were identified in only one tow.

Six species comprised 75%, by number, of the specimens collected (Table 5). Atlantic croaker represented 27%, gulf menhaden 23%, spot 14%, sand seatrout 4%, bay anchovy 4%, and hardhead catfish 3%.

Bay-wide, the most abundant species (by weight) was Atlantic croaker, comprising 27% of the bycatch; gulf menhaden accounted for 21% and spot 13% of total biomass. Sand seatrout, cutlassfish, striped mullet, threadfin shad, hardhead catfish and pinfish accounted for 15% of the total biomass. Thus, 9 of the 66 species comprised 76% of bycatch biomass during late May through mid-November.

Species abundance varied somewhat between bay areas (Table 6). In Trinity Bay, 33 finfish species were taken in the bycatch. Atlantic croaker was the dominant species in both number of individuals (35%) and biomass (43%); greatest catches came during June through August (Figure 4). It should be noted that CPUE values reported for the Bessette study were calculated only from the tows in which individual species occurred and not from the total number of tows sampled. Other species with

high CPUE during certain months included southern flounder (August) and gulf menhaden (November).

A total of 34 species was found in the bycatch in Upper Galveston Bay. Atlantic croaker was the dominant species in both number (39%) and biomass (54%). This species was also taken most frequently during June through August (Figure 5). Other finfish species with high CPUE during certain months included gulf menhaden (increasing from June through September) and hardhead catfish (August and September).

In West Bay, 31 species were found in the bycatch, with Atlantic croaker dominant species in both number (40%) and biomass (31%). Greatest catch rates for this species occurred during June through August (Figure 6). Gulf menhaden CPUE was greatest in June, cutlassfish in May, and gafftopsail catfish during August.

In Lower Galveston Bay, 58 species were found in the bycatch. Atlantic croaker were dominant species in number caught (21%), but most of the biomass was attributable to gulf menhaden (25%). Atlantic croaker was most common during May through August, with gulf menhaden common during July (Figure 7).

In East Bay a total of 42 species was found in the bycatch, with gulf menhaden dominant in number (29%) and biomass (43%). Greatest CPUE for gulf menhaden occurred from July through October (Figure 8). In the "far" West Bay and Chocolate Bay area, 39 species were found in the bycatch. Spot was dominant in both number (25%) and biomass (30%). Spot was most common during most months sampled; Atlantic croaker was common from May through August and gulf menhaden common in May and July through September (Figure 9).

Atlantic croaker was the most abundant fish in both number and weight in three of the six major areas (Trinity Bay, West Bay and Upper Galveston Bay), and by number in 4 of the 6 major areas (Trinity Bay, Lower Galveston Bay, West Bay and Upper Galveston Bay). In East bay, gulf menhaden was the most abundant species in both number and weight. Spot was the most important species in both categories in "far" West Bay and Chocolate Bay. Hardhead catfish were relatively abundant only in Upper Galveston Bay where they constituted more than 13% of the number and 8% of the weight.

No two areas had the same fish species composition. Greatest variety (58) was observed in Lower Galveston Bay. Conversely, only 33 fish species were identified from Trinity Bay and 34 species from Upper Galveston Bay. Greatest biomass of bycatch species occurred in Lower Galveston Bay.

With the exception of gulf menhaden, Atlantic croaker and sand seatrout, species of special interest or commercial value were usually found at very low levels during the study. Although gulf butterfish (*Peprilus burti*) were observed in all months except July in West Bay, Lower Galveston and East Bays, abundance levels were moderate in all three areas. Black drum occurred only in September and October. Southern flounder was recorded in 28 of 107 tows, occurring in at least one tow each month. However, there appeared to be substantial differences in distribution of southern



flounder within bay areas. Both the largest number and highest biomass of southern flounder were found in Trinity Bay (Table 6).

Eight species of invertebrates were present in the bycatch (7 crustaceans and 1 mollusk; Table 7). Blue crab (present in 56 of 107 tows) and Atlantic brief squid (present in 47 tows) were caught in every sampling month. Blue crab were taken from every area, and Atlantic brief squid from all areas except Trinity Bay. Lesser rock shrimp, mantis shrimp, lesser blue crab, and a shrimp reported as *Crangon normanni* (probably *Alpheus normanni*, Green Snapping Shrimp; Williams et al. 1988) were recorded only during October and November. Iridescent swimming crab occurred as early as August, but was more frequent during October and November.

Blue crab CPUE was highest during June (18.8 kg/hr), followed by July (3.8 kg/hr) and October (3.2 kg/hr). Blue crab catches from Trinity Bay exceeded those for the other areas (16 of 20 tows sampled for bycatch species, and 6.8 kg/hr). Only in Lower Galveston Bay were blue crabs nearly as frequent (16 of 21 tows), but mean CPUE was only 3.1 kg/hr. A blue crab CPUE of 3.6 kg/hr was reported from Upper Galveston Bay (sampled only through September).

Atlantic brief squid, unlike blue crabs, were never reported from the Trinity Bay area. Squid catches were most frequent in West Bay and Lower Galveston Bay, with mean CPUE maximum in Lower Galveston Bay (2.1 kg/hr).

West Bay: As previously indicated, catch ratio of bycatch to shrimp, bycatch percentage, and bycatch abundance (CPUE) from this shrimper were significantly less than those of shrimpers in all other areas (Figures 3, 10 and 11). In only one month (September) did the bycatch ratio approach that reported by shrimpers in other areas. However, his average shrimp catch ( $22.0 \pm 21.5$  kg/hr) was not significantly less than that of other bait shrimpers during the same period ( $14.4 \pm 21.3$  kg/hr; Figure 12). In fact, it was second only to that of the shrimper who worked farther west in West Bay and Chocolate Bayou. It is of interest that the West Bay fisherman's tow times were longer than those of most other shrimpers during the same months (Figure 13). Thus, his lower bycatch resulted either from real differences in bycatch distribution in the bay areas in which he fished, or his shrimping techniques, including his gear, provided a cleaner shrimp catch despite longer tow times.

### *Lamkin Study*

Lamkin accompanied one fisherman in West Bay between July 1981 and June 1982. As in the Bessette study, bycatch was relatively low, both for total bycatch weight and ratio of bycatch:shrimp. Monthly fish:shrimp mean ratios ranged from 0.16 in July to 0.7 in December (values converted from those originally expressed as shrimp:fish) (Table 8). Monthly bycatch ranged from 16.9 to 42.4% of each monthly yield, with an average of 27.2% of total catch (Table 2). Lamkin identified 52 species of finfish and 4 invertebrates as compared with 30 fish and 3 invertebrate species in this area listed by Bessette.

During Lamkin's study, the five most numerous species and their percentage's of total bycatch were Atlantic croaker (31.2%), sand seatrout (16.2%), blue crab (9.7%), spot (9.5%), and gulf menhaden (4.3%). In terms of biomass, Atlantic croaker were dominant (24.8%), followed by blue crab (21.4%), sand seatrout (8.1%), spot (7.2%) and gulf menhaden (3.5%).

Atlantic croaker were numerically abundant in all months from May through September (Figures 14 - 17). Croaker accounted for 17.5% of the bycatch in July, increased to 20% in August, then gradually declined to under 4% in December. During the next season, May and June were months of peak abundance, accounting for 65.7% and 46.8% of the bycatch, respectively.

Sand seatrout were numerous in bycatch from July through December (Figures 14-17). However, even though this species was important in total numbers, sand seatrout contributed little to total biomass of the catch. In July, sand seatrout constituted 21.4% of the catch by number, but only 4% of the biomass (Figure 14). In September the biomass increased to 12%, but did not increase above this value until December when sand seatrout represented 52% of the individuals and 28% of the weight (Figures 16 and 17).

Overall, in the bycatch, blue crab were the third most numerous species. However, they accounted for 92% of the invertebrate bycatch biomass. Blue crabs were common throughout the year, except during December (Figures 14-17). Catch peaked in July 1981 (12.5%) and May 1982 (21.7%).

Spot were present in the bycatch throughout the sampling period (Figures 14-17). Yet it was an important part of the biomass only in July (17.5%), November (9%), and June (19%). In each of the other months, spot accounted for less than 6% of the bycatch.

Gulf menhaden was the fifth most numerous species in the bycatch. Gulf menhaden were taken in trawls during all months, but were most abundant during June through December (Figures 14-17). November was the greatest month in terms of total number (11%), whereas December was the peak month for biomass (15%).

In his report, Lamkin compared shrimp catch by this West Bay fisherman to other bait shrimpers (as reported by NMFS). He estimated this West Bay fisherman's shrimp CPUE (a peak 26.5 kg/hr) was about 50% less than that of other bay bait shrimpers. This contrasts with the equal or slightly improved CPUE by this fisherman determined in direct comparison with shrimpers in other bay areas (Zein-Eldin and Bessette, in prep.). Lamkin's statistical methods are not detailed and his raw data are not available for analysis. However, it may be possible Lamkin compared the NMFS monthly reports of catch (lb) and effort (hr) with the West Bay fisherman's figures in kg/hr (1 kg=2.2 lb), perhaps explaining the 50% difference in shrimp CPUE. Lamkin further projected total bay bycatch based upon monthly shrimp:fish ratios (expressed in this review as fish:shrimp ratios) he had calculated from his samples. Extrapolating these very low ratios to the estimated Galveston Bay bait production, he concluded that fish bycatch was minimal for all Galveston Bay bait shrimpers.



## *Matlock Study*

This study was limited to gulf flounder and southern flounder catch associated with Texas bay shrimp trawling; numeric abundance's were determined . Total flounder catch by commercial bay shrimpers was estimated based on coast-wide catches and total numbers of Texas bay shrimping licenses. Table 3 presents monthly numeric catch of southern flounder and the various areas of Galveston Bay that were sampled. Southern flounder bycatch in Galveston Bay was less than that for any other Texas bay system except Upper Laguna Madre. There were no catches of gulf flounder in Galveston Bay, although other flatfishes, including bay whiff, hogchoker, blackcheek tonguefish, lined sole and ocellated flounder were all present at some time during the sampling period.

## SUMMARY

1. Only three projects have directly assessed shrimp trawl bycatch in Galveston Bay. Matlock (1982) conducted a TPWD study of the flounder bycatch from bay commercial and bait shrimpers throughout the state. Lamkin (1984) monitored shrimp and bycatch on a single bait shrimp vessel periodically for eight months. Bessette (1985) conducted a similar study using six bait shrimpers throughout the Galveston Bay system for seven months.
2. Baywide bycatch averaged about 65% of the total catch by weight during the Bessette study.
3. Baywide bycatch CPUE averaged about 35.3 kg/hr, with an average shrimp harvest of 15.3 kg/hr during the Bessette study.
4. Atlantic croaker was the dominant (number) bycatch species in 4 of the 6 major areas (Trinity Bay, Lower Galveston Bay, West Bay and Upper Galveston Bay), with gulf menhaden dominant in East Bay and spot dominant in "far" West Bay and Chocolate Bay.
5. Atlantic croaker was the dominant (biomass) bycatch species in 3 of the 6 major areas (Trinity Bay, West Bay and Upper Galveston Bay), with gulf menhaden dominant in 2 of the other areas (East Bay and Lower Galveston Bay), and spot dominant in the last area ("far" West Bay and Chocolate Bay).
6. Some important special interest species such as southern flounder, red drum and spotted seatrout occurred infrequently in the sampled trawls.

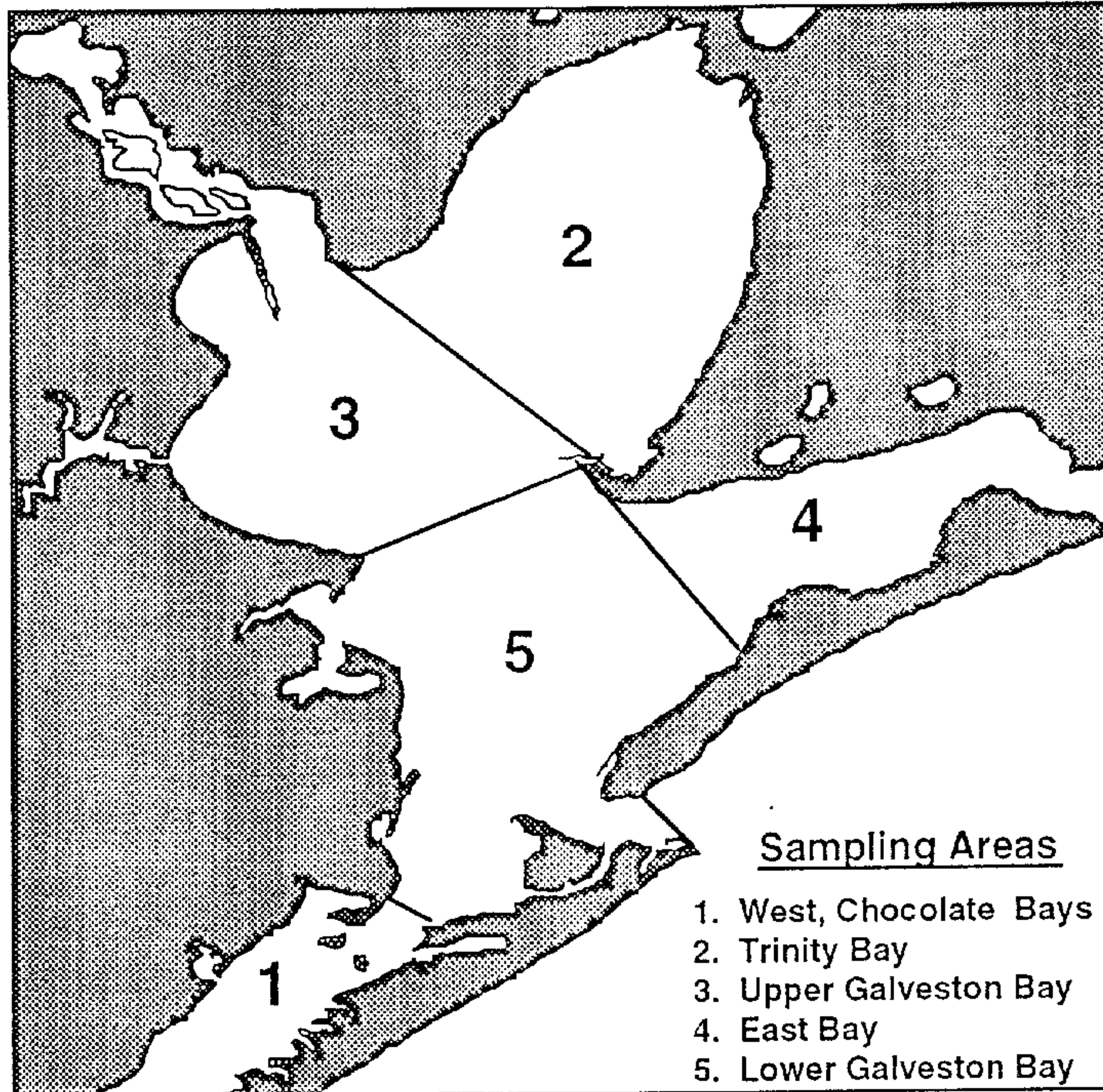


Figure 1. Galveston Bay bait shrimping areas sampled by Bessette (1985).



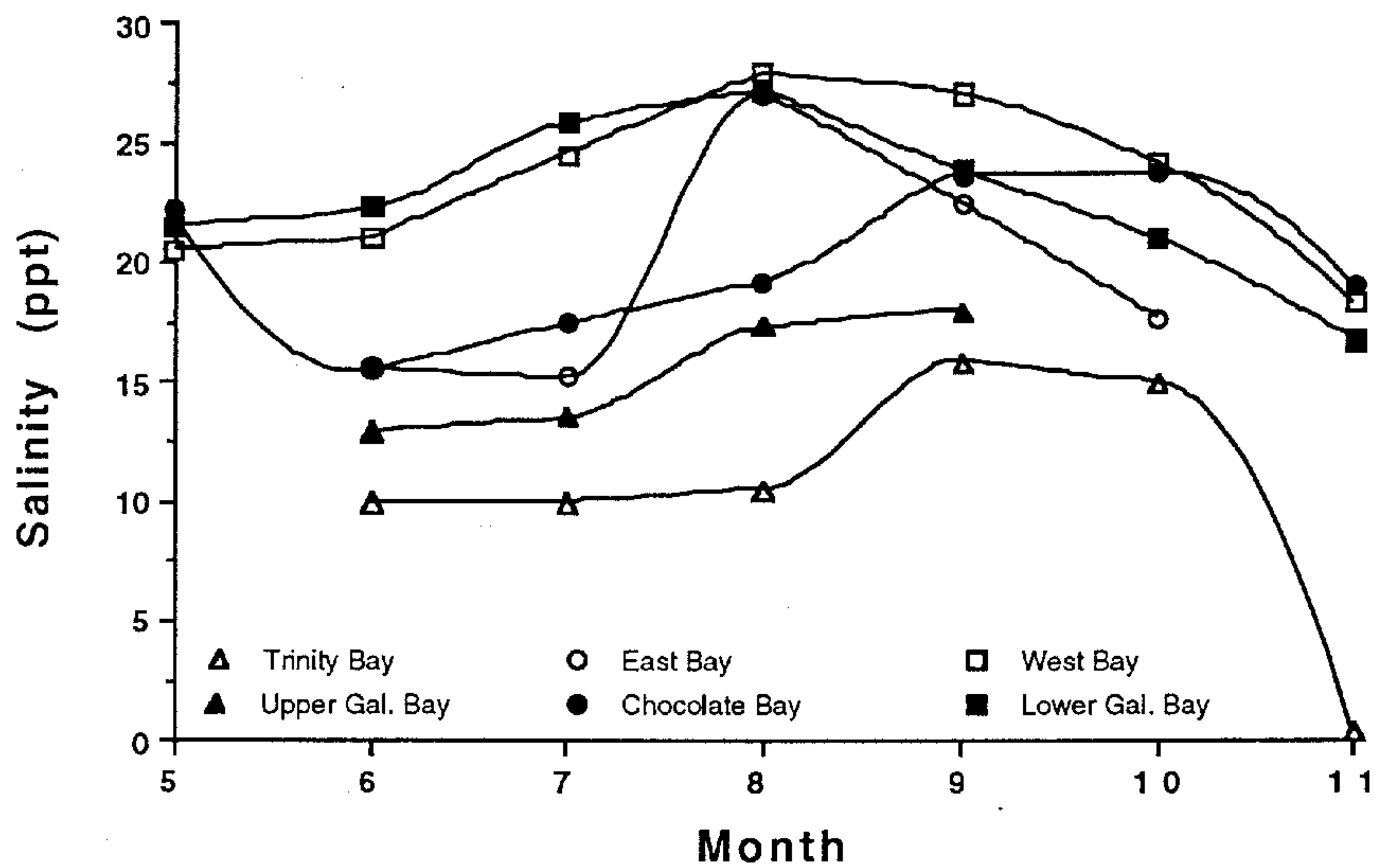


Figure 2. Mean salinities in Galveston Bay during 1984 sampling period (data from Bessette 1985.)

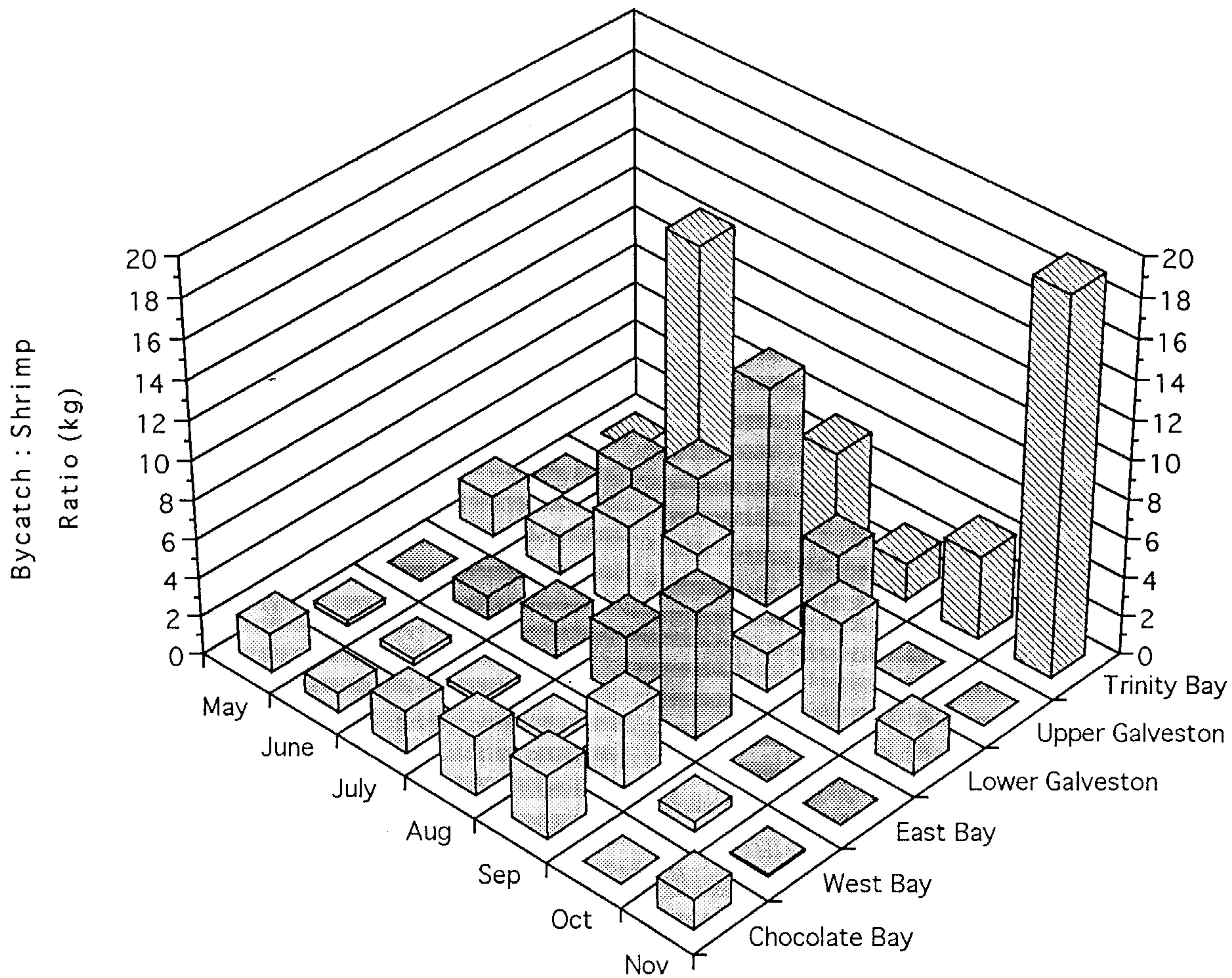


Figure 3. Mean bycatch : shrimp ratio by area and month (data from Bessette, 1985).



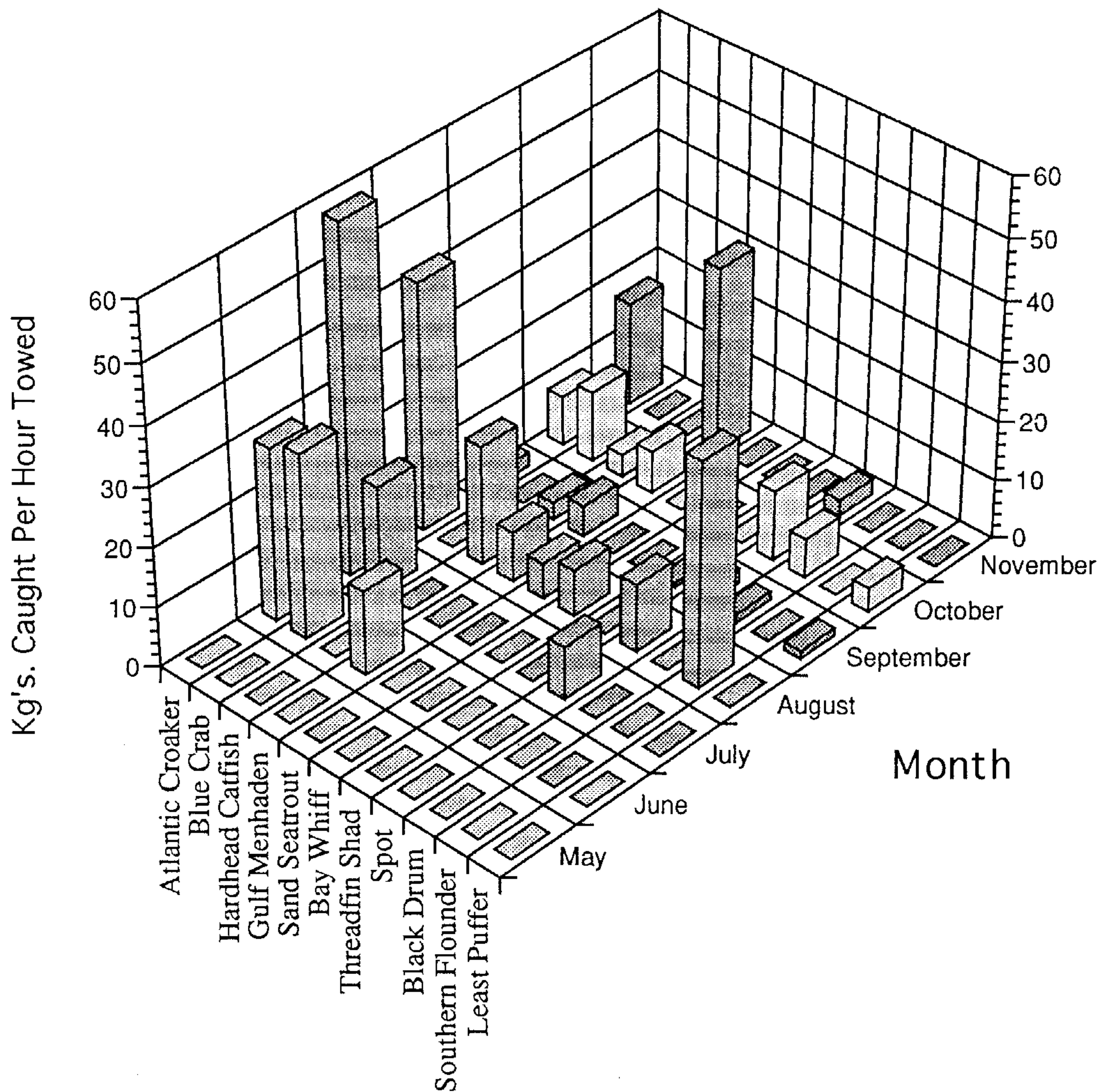


Figure 4. Monthly CPUE of dominant bycatch species caught in Trinity Bay (data from Bessette, 1985).

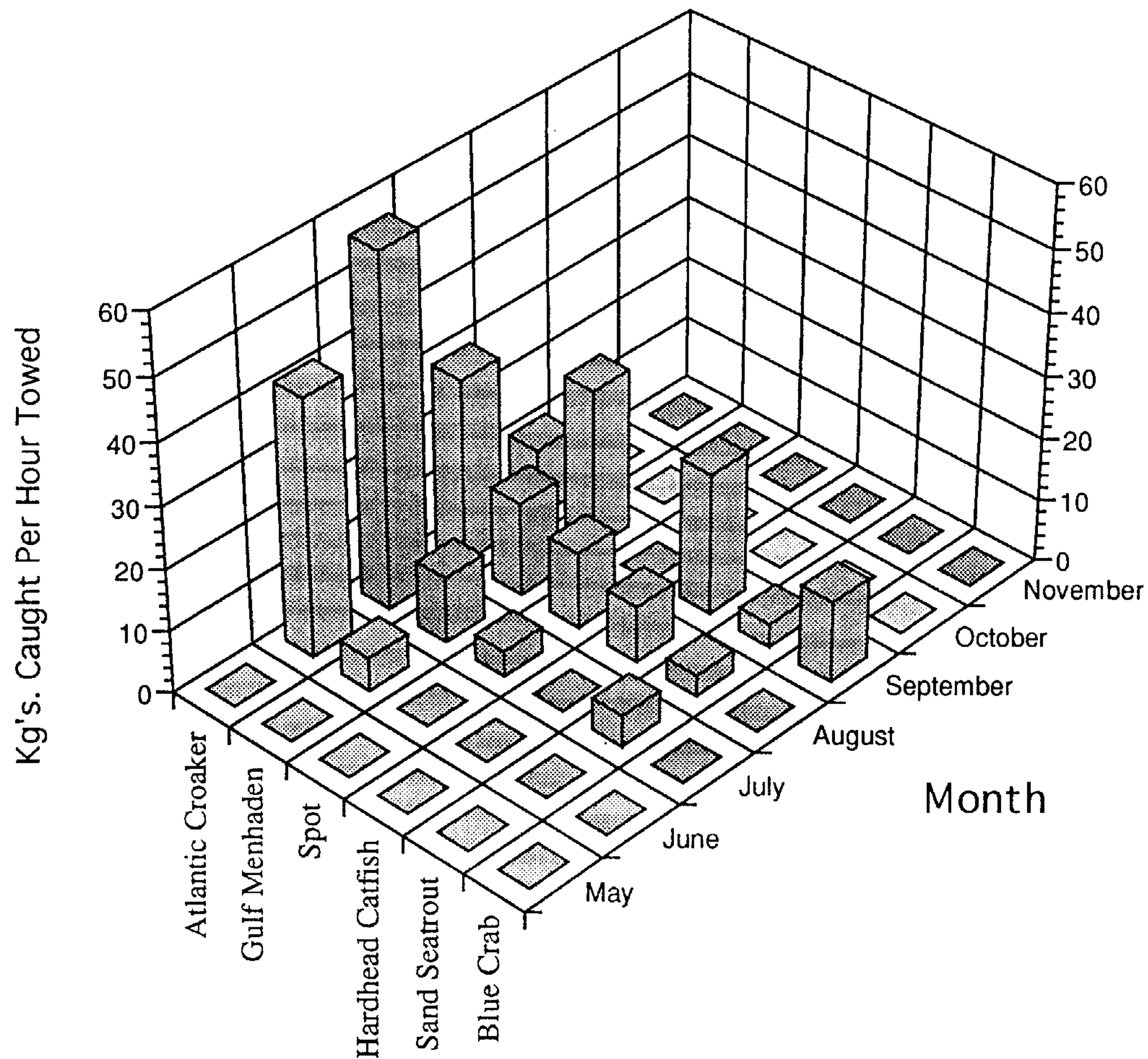


Figure 5. Monthly CPUE of dominant bycatch species in upper Galveston Bay (data from Bessette, 1985).



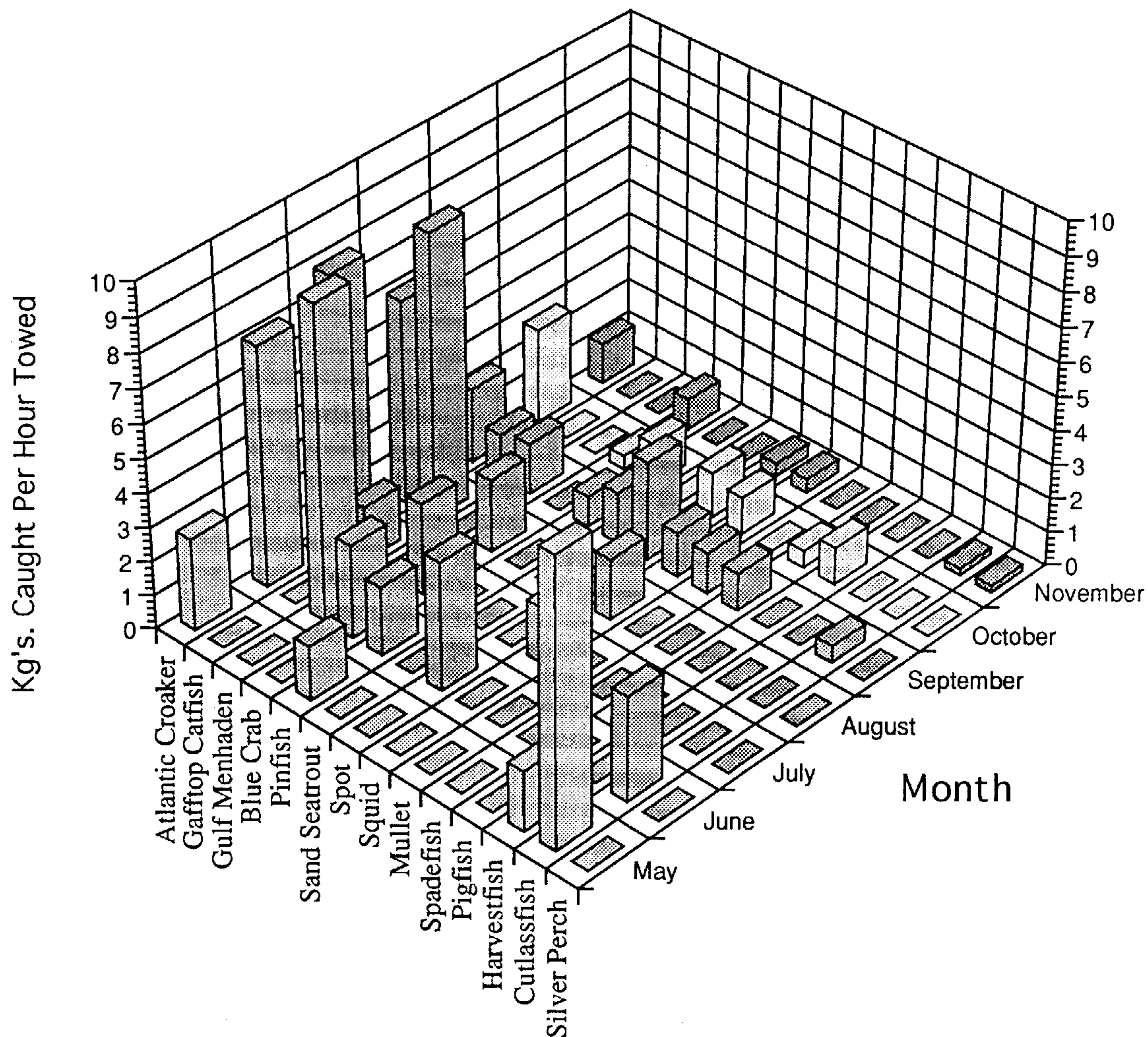


Figure 6. Monthly CPUE of dominant bycatch species in west Galveston Bay (data from Bessette, 1985).

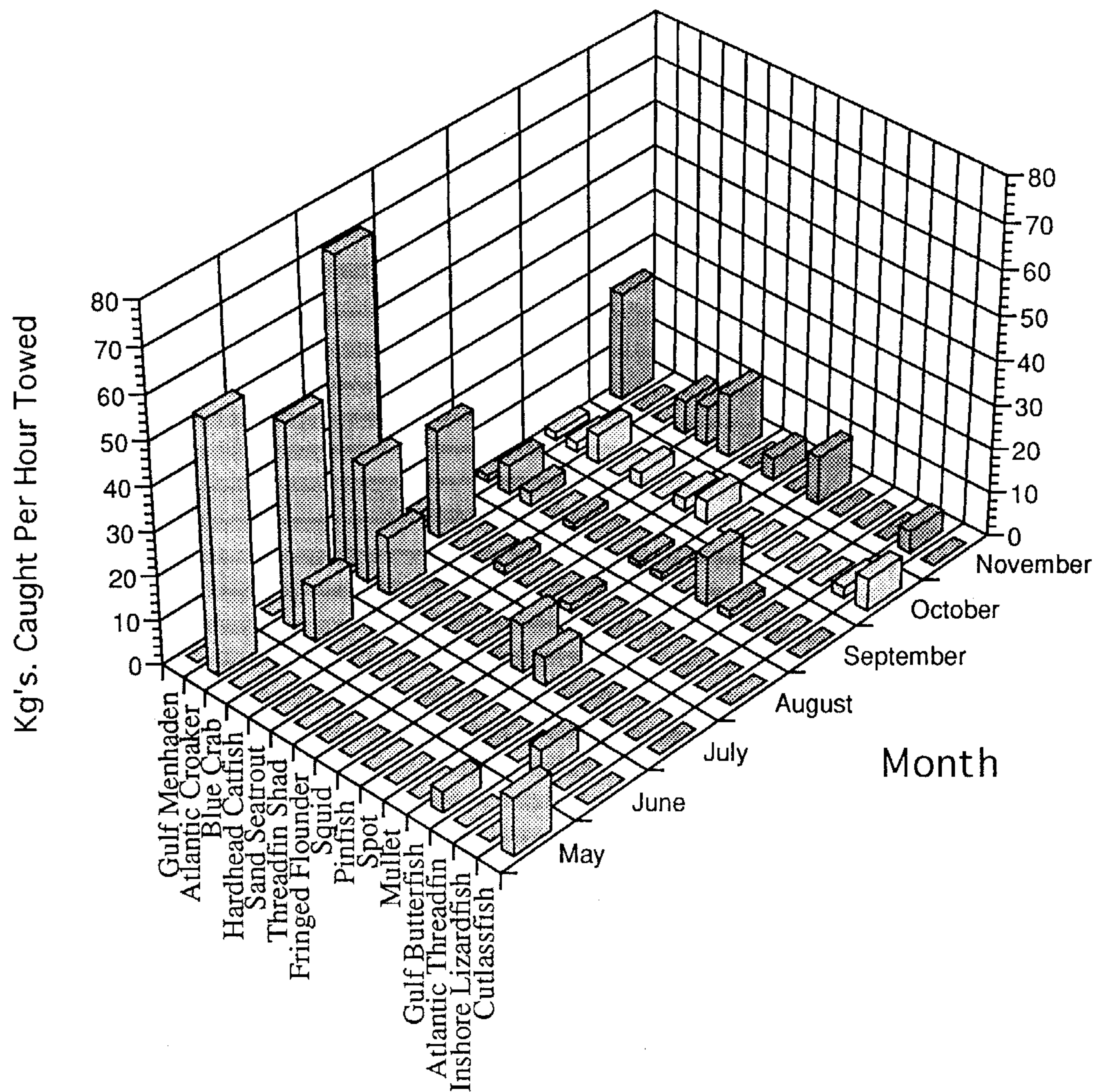


Figure 7. Monthly CPUE of dominant bycatch species in lower Galveston Bay (data from Bessette, 1985).



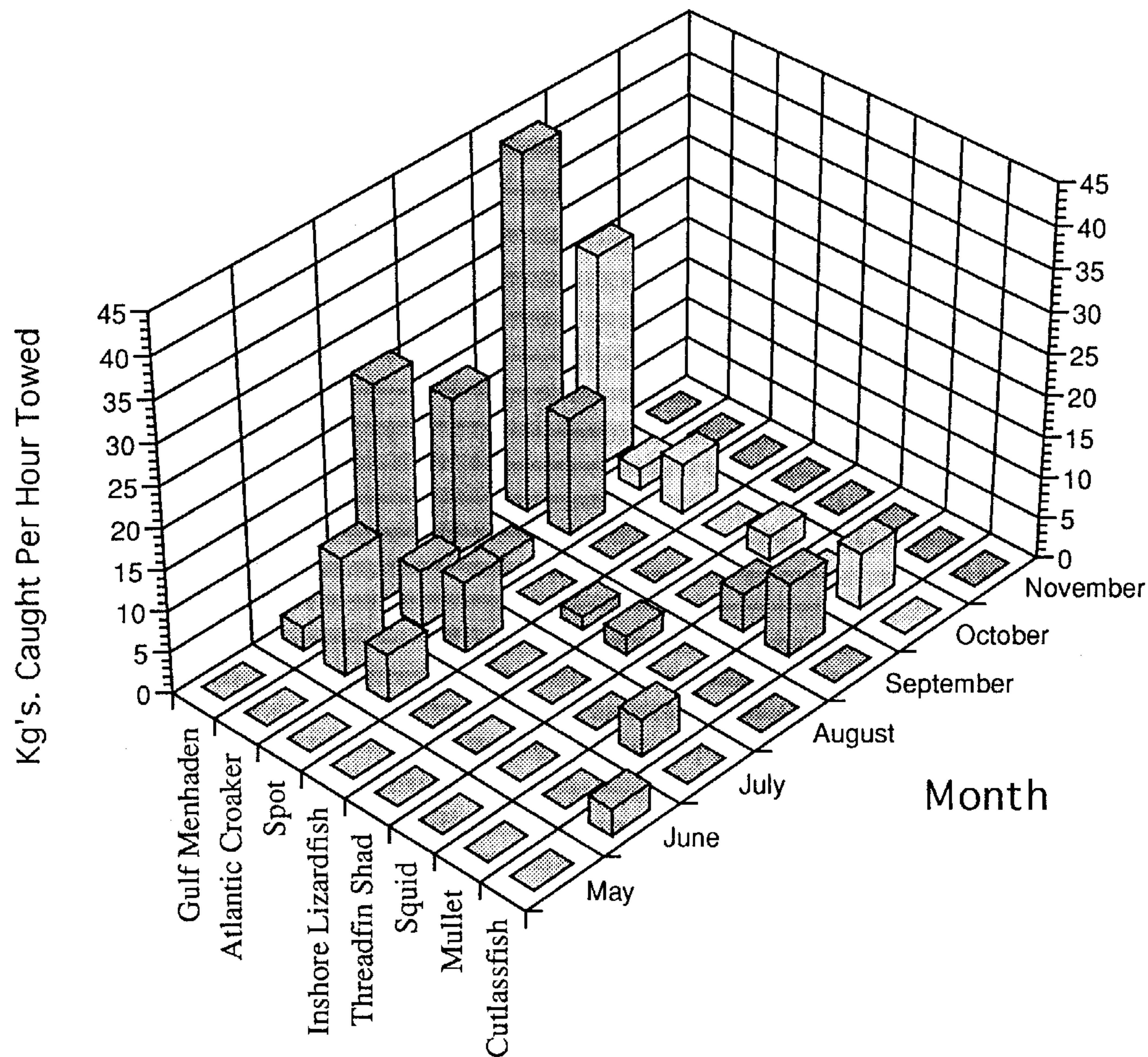


Figure 8. Monthly CPUE of dominant bycatch species in East Bay (data from Bessette, 1985).

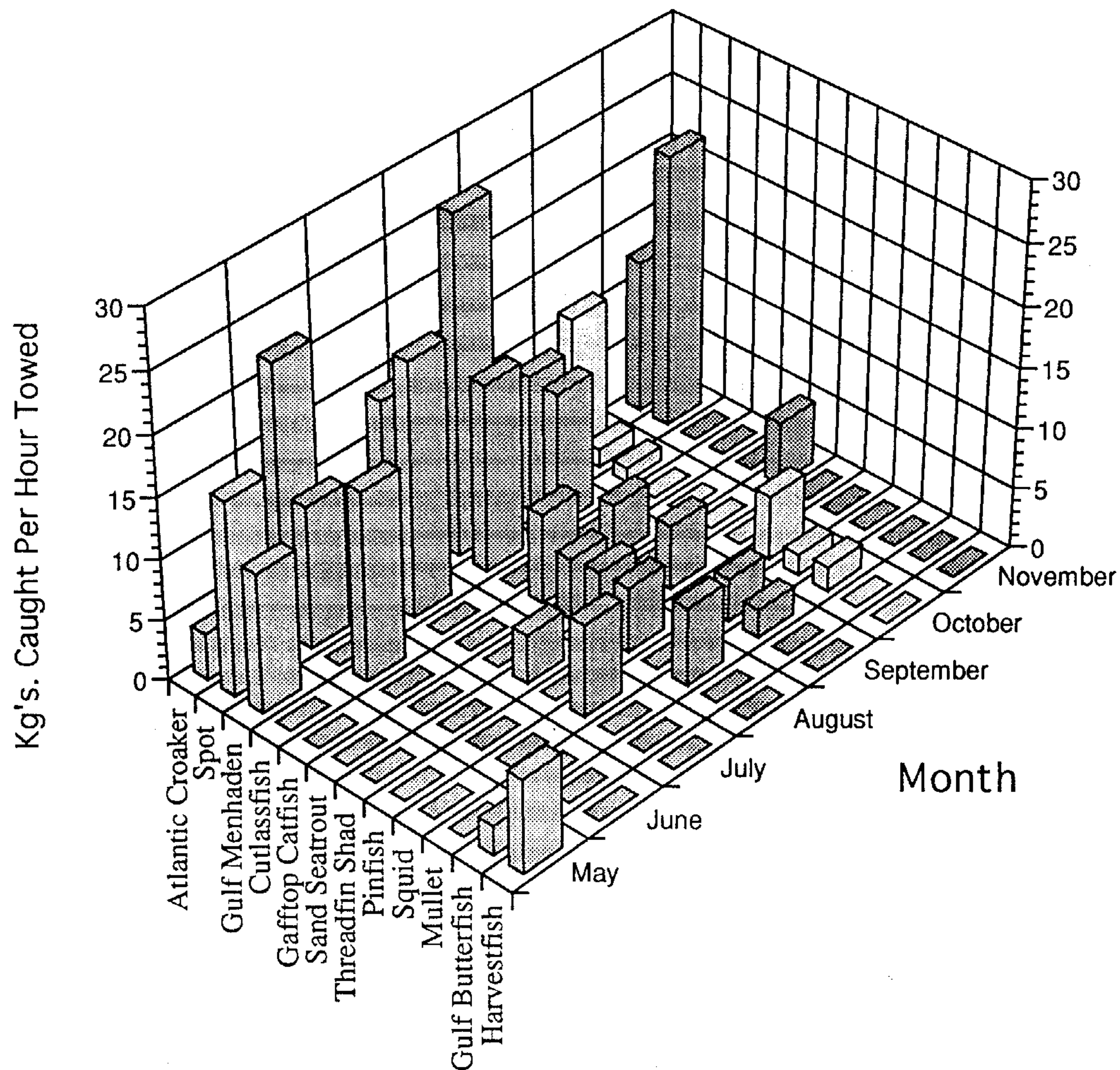


Figure 9. Monthly CPUE of dominant bycatch species in Chocolate Bay (data from Bessette, 1985).



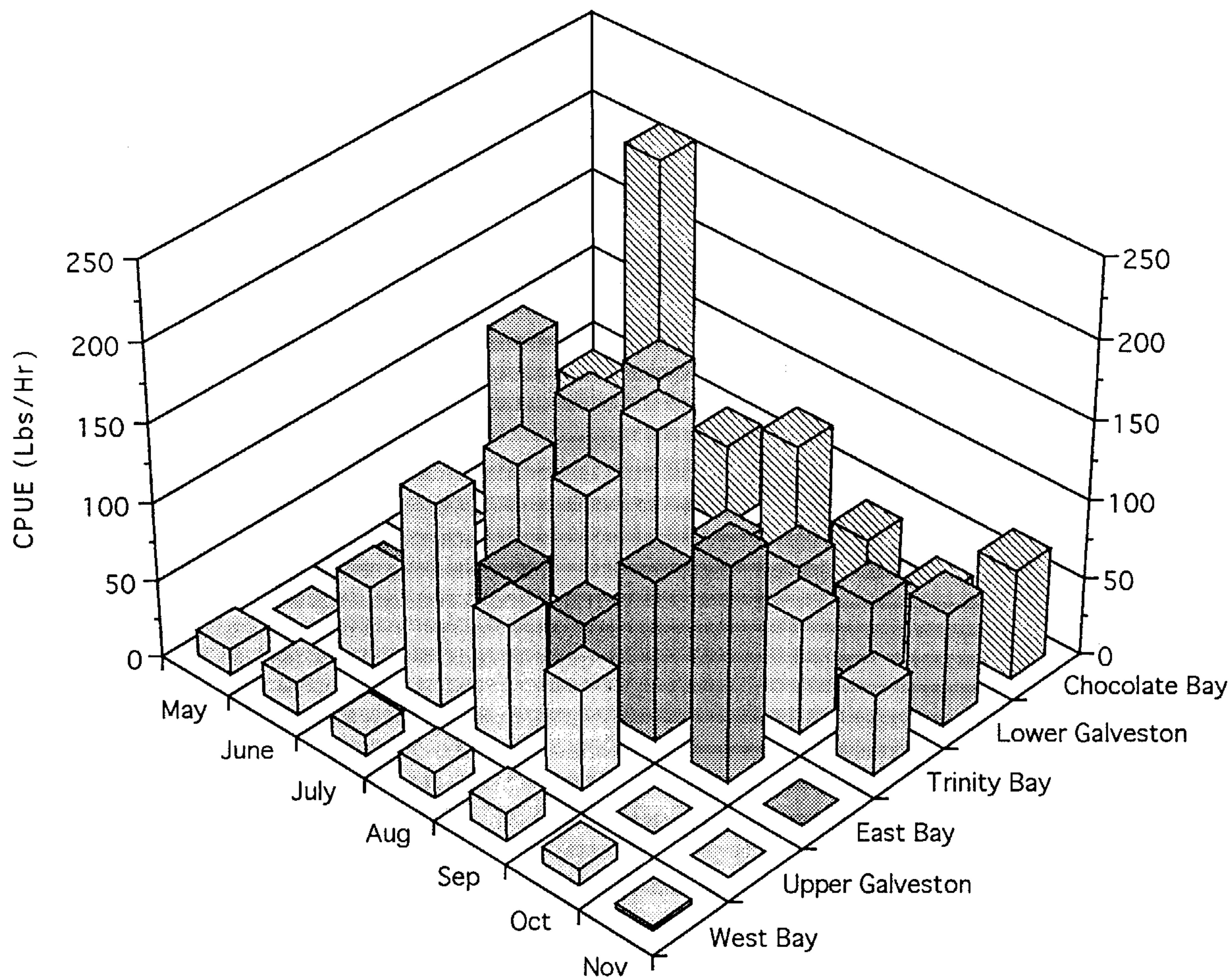


Figure10. Bycatch CPUE in Galveston Bay by area and month (data from Bessette, 1985).



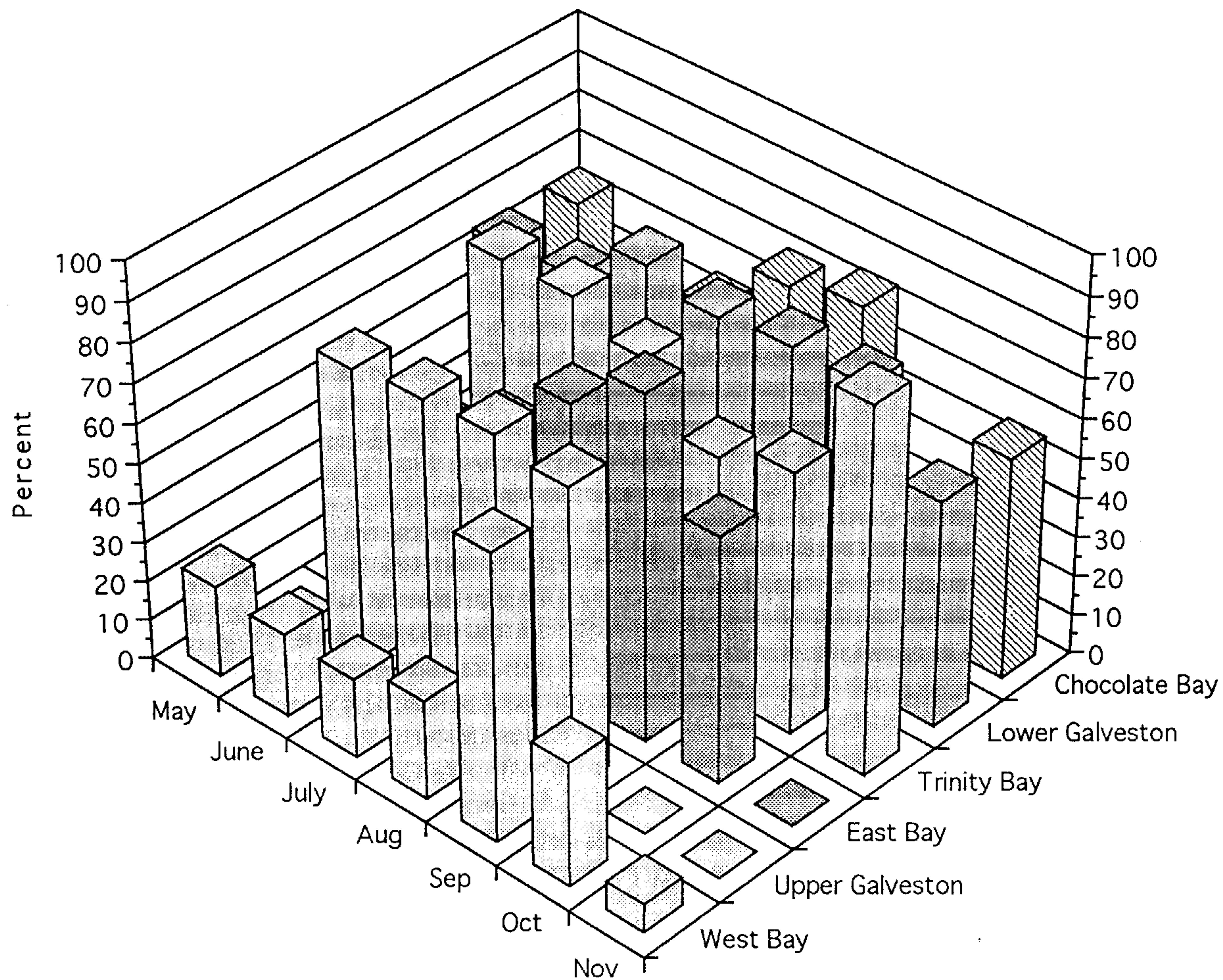


Figure 11. Bycatch as percent of total catch weight in Galveston Bay (data from Bessette, 1985).



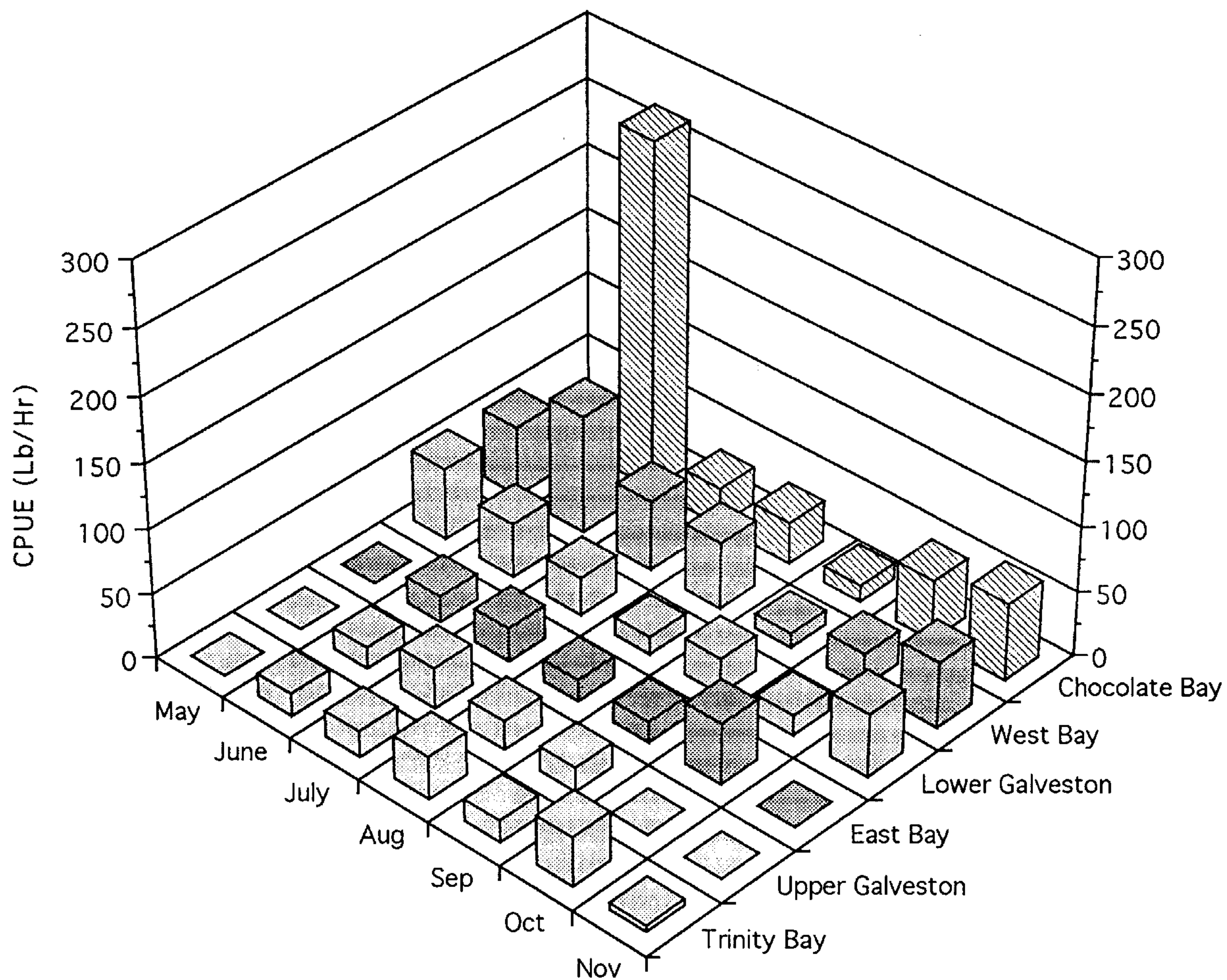


Figure 12. Shrimp CPUE in Galveston Bay by area and month (data from Bessette, 1985).

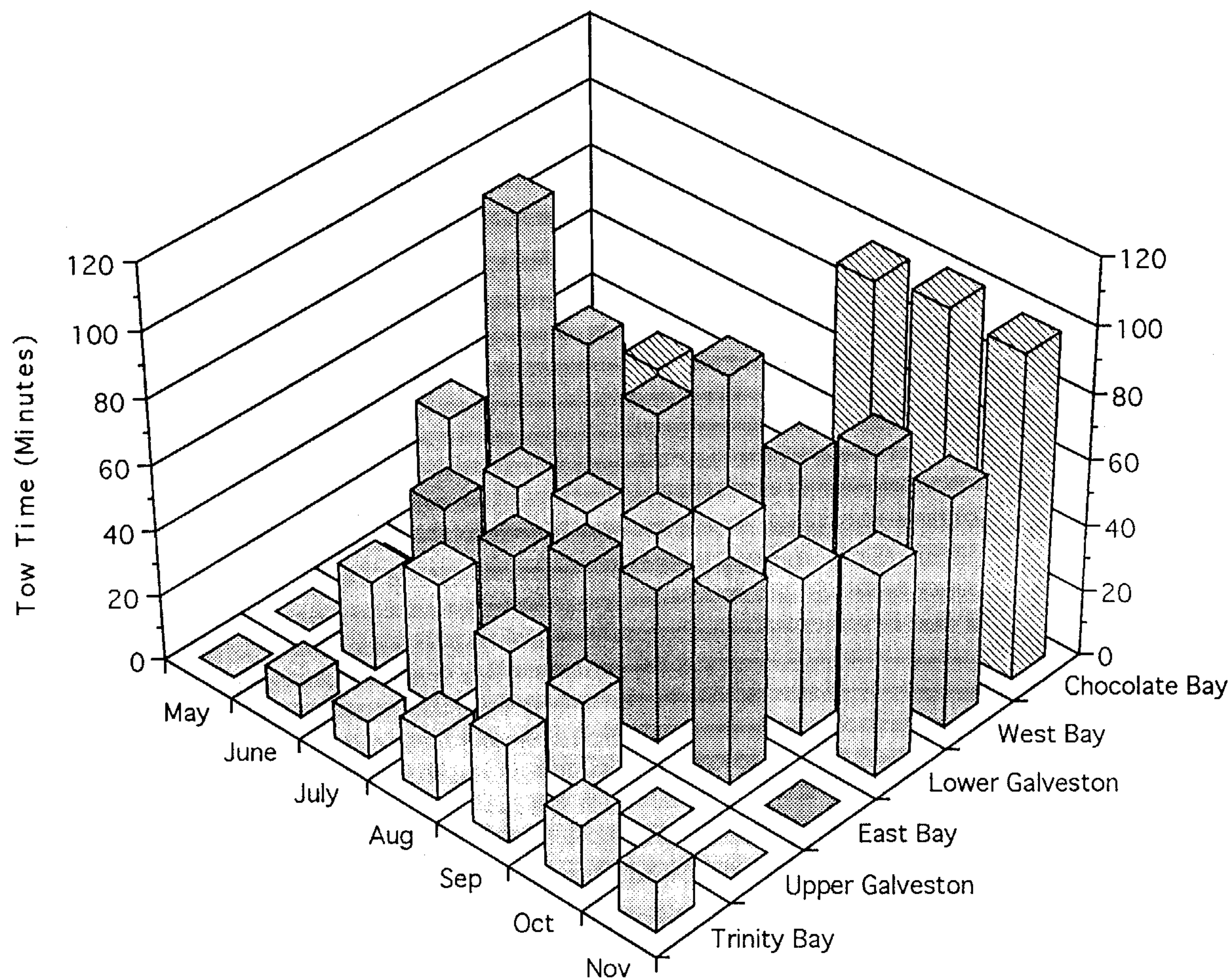
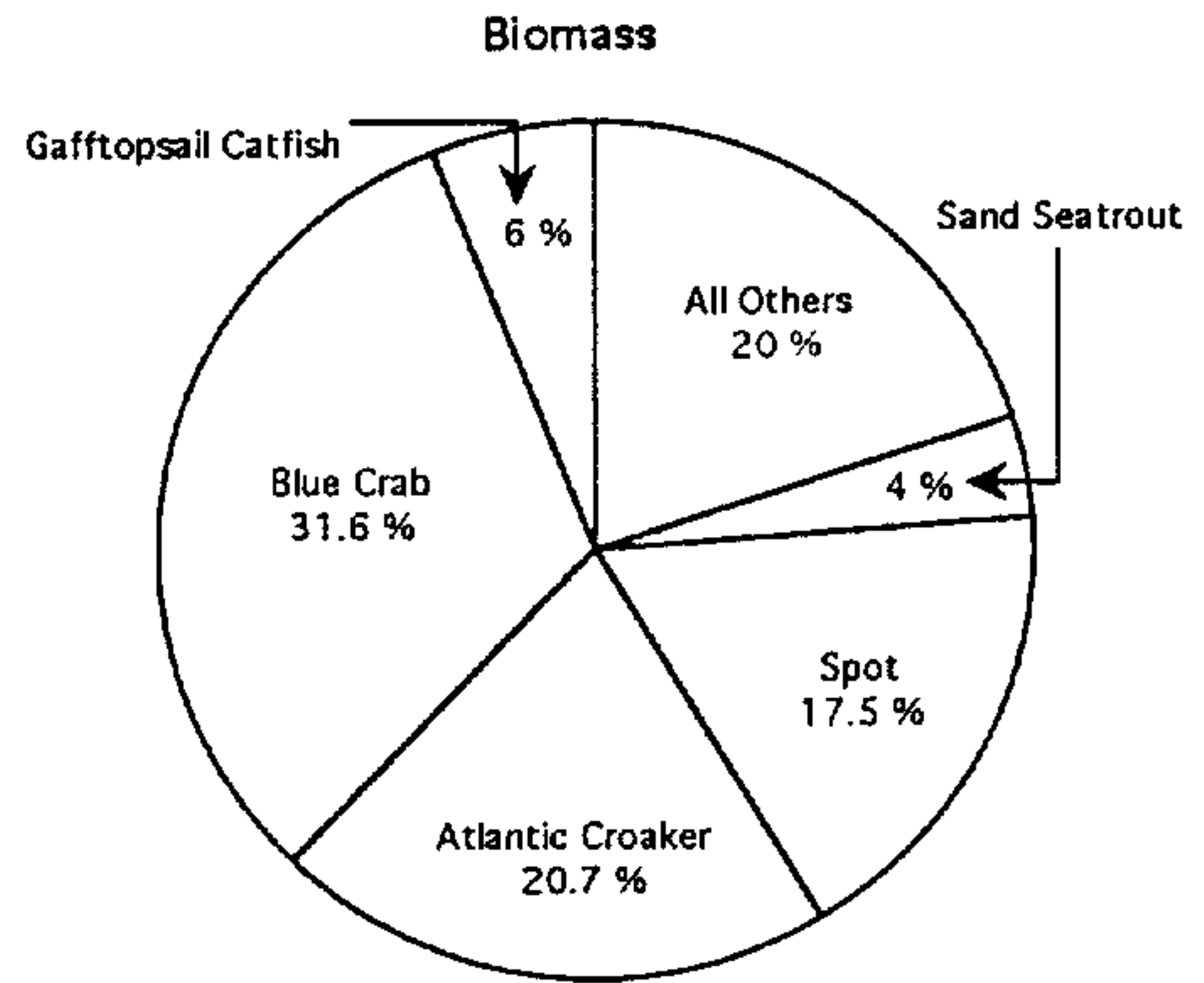
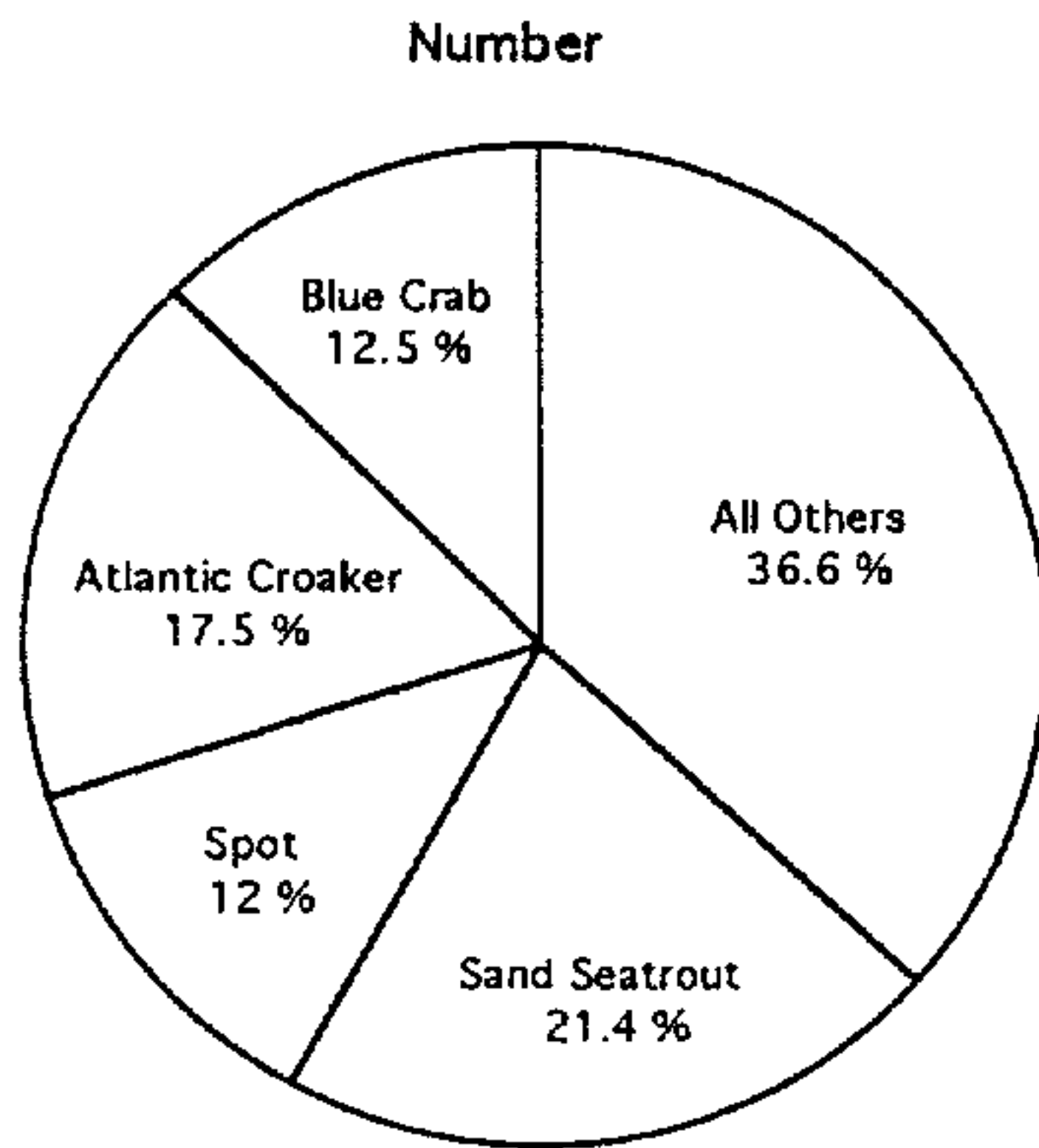


Figure 13. Mean tow duration by area and month (data from Bessette, 1985).



July 1981



August 1981

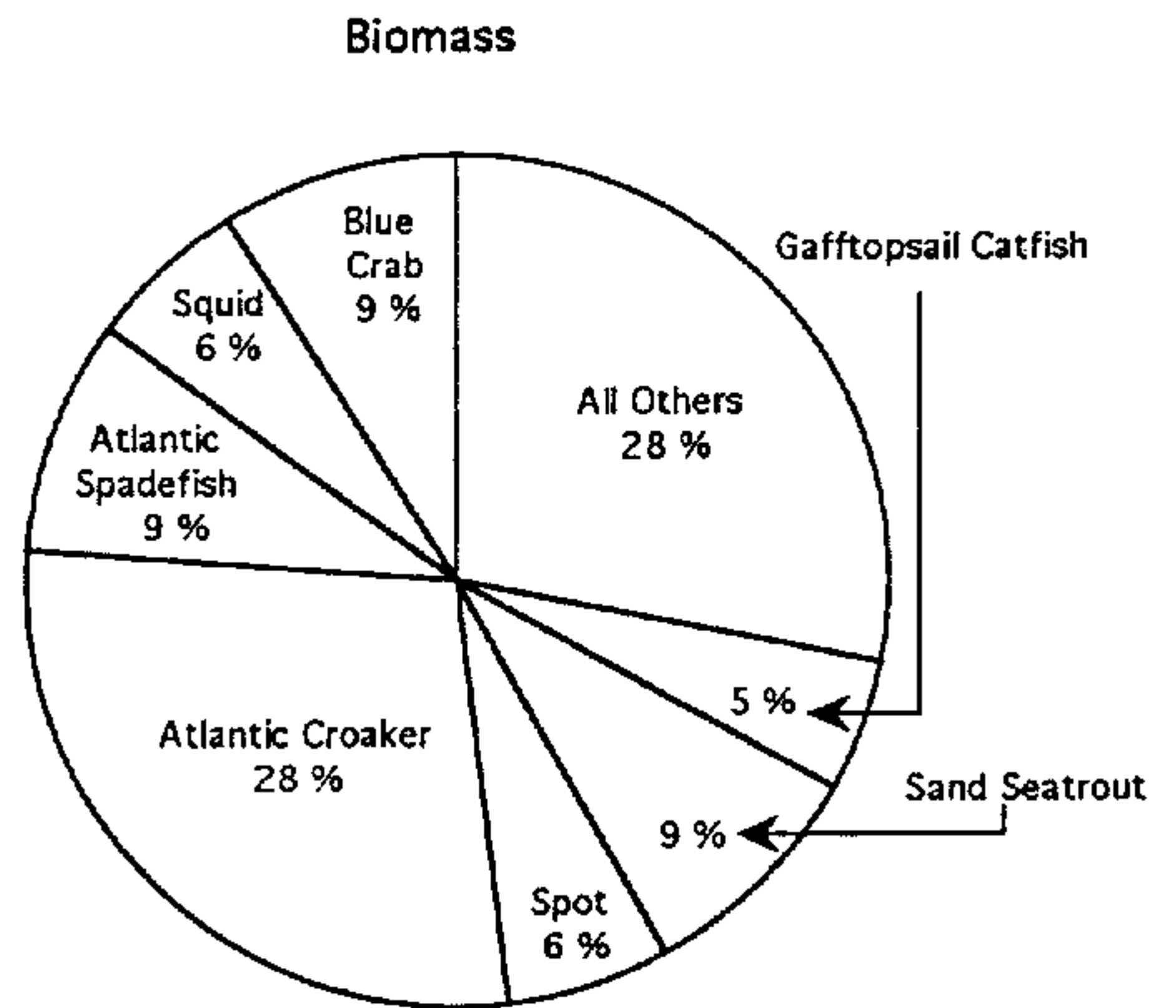
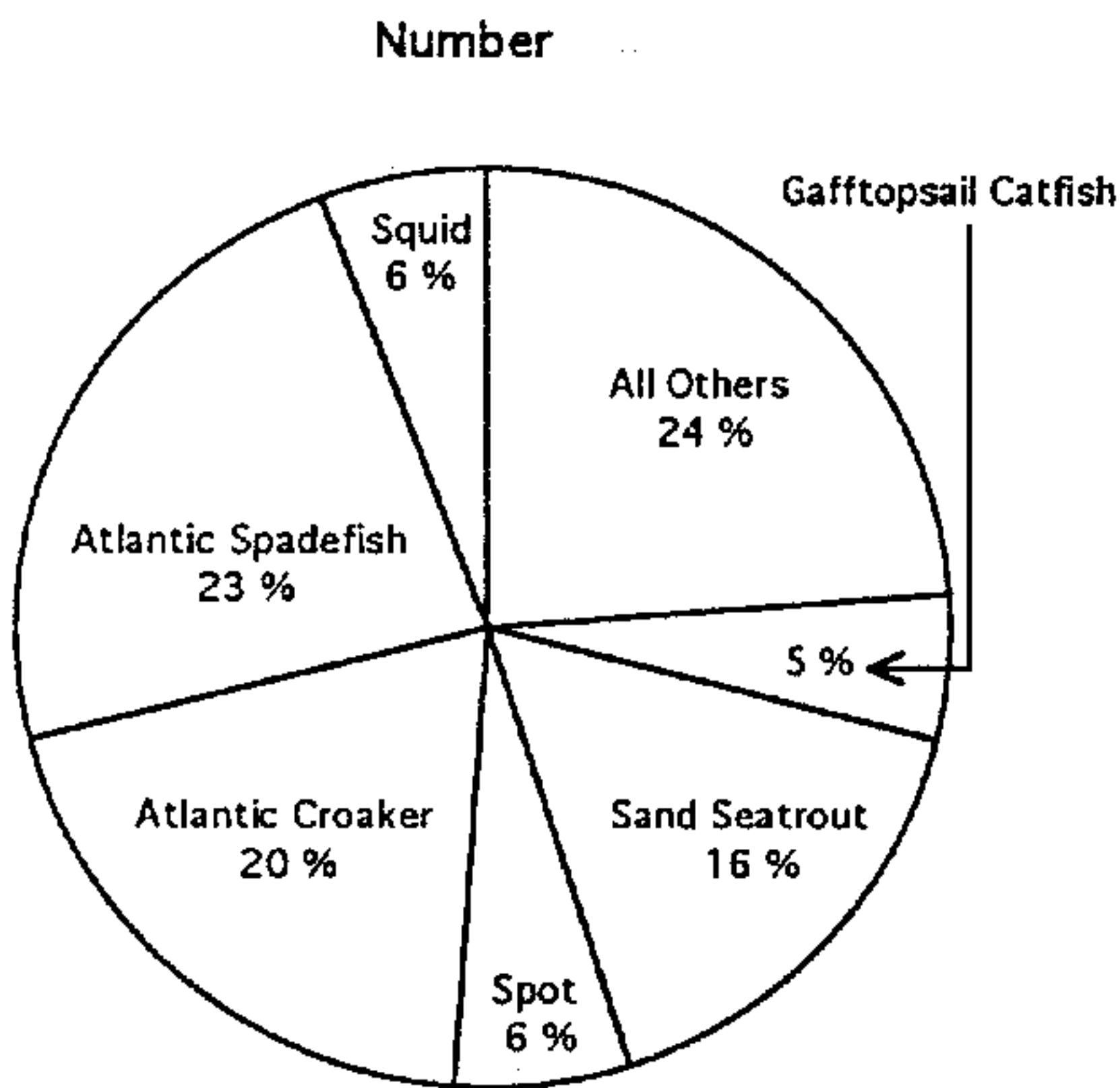
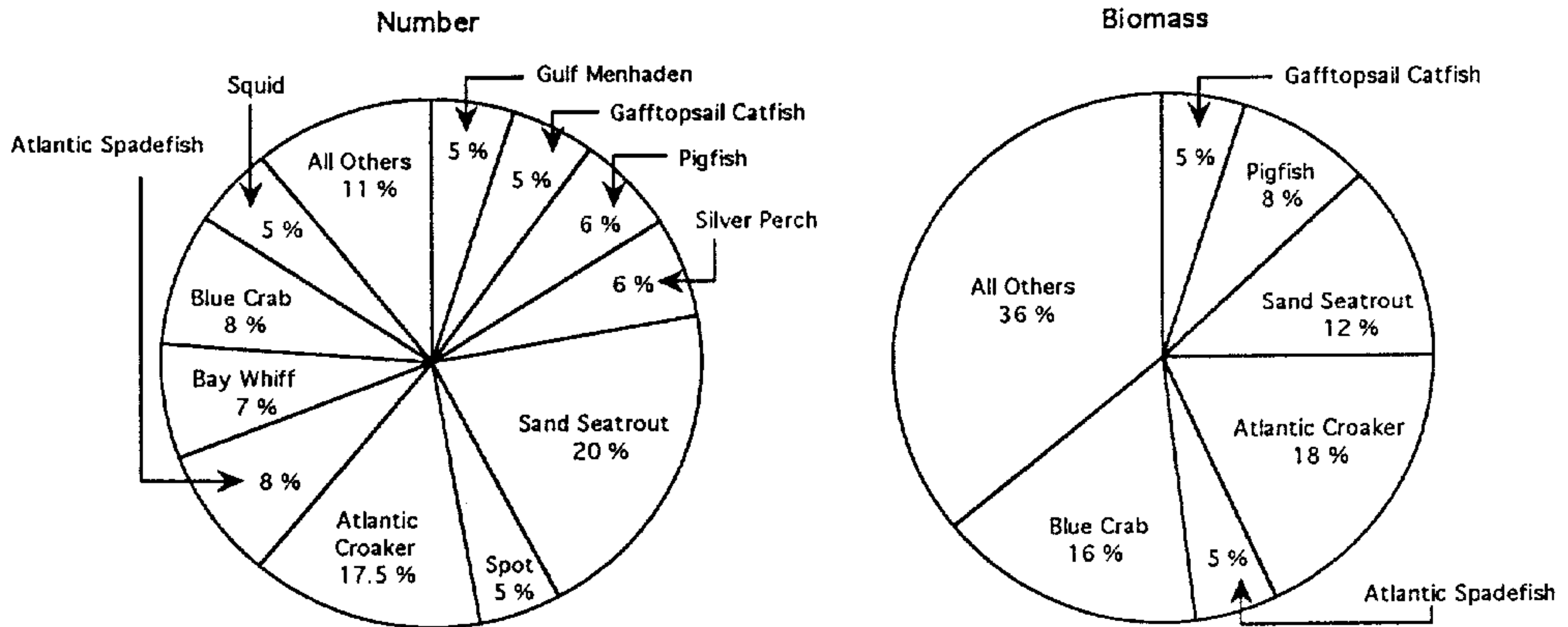


Figure 14. Percent of total bycatch (number and biomass) contributed by dominant fish and/or invertebrates during July and August 1981 (from Lamkin 1984).

## September 1981



## October 1981

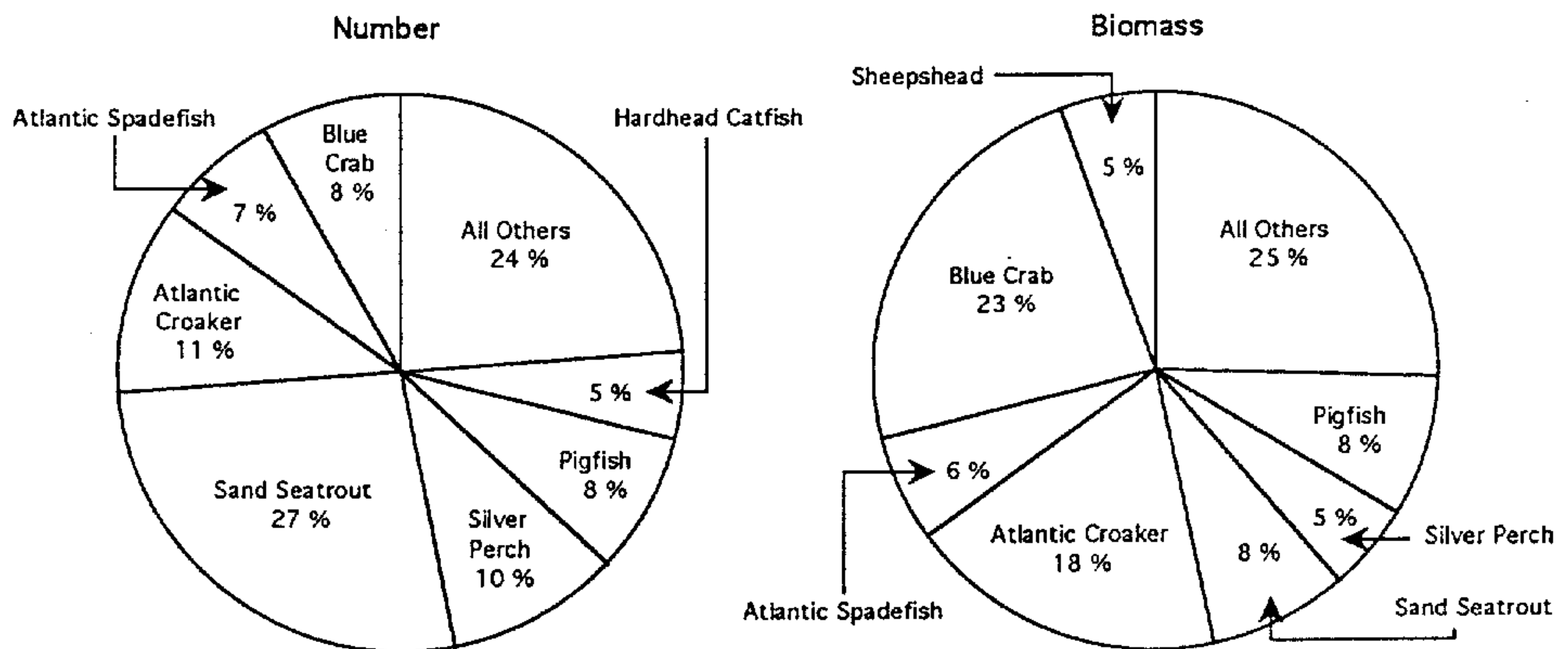
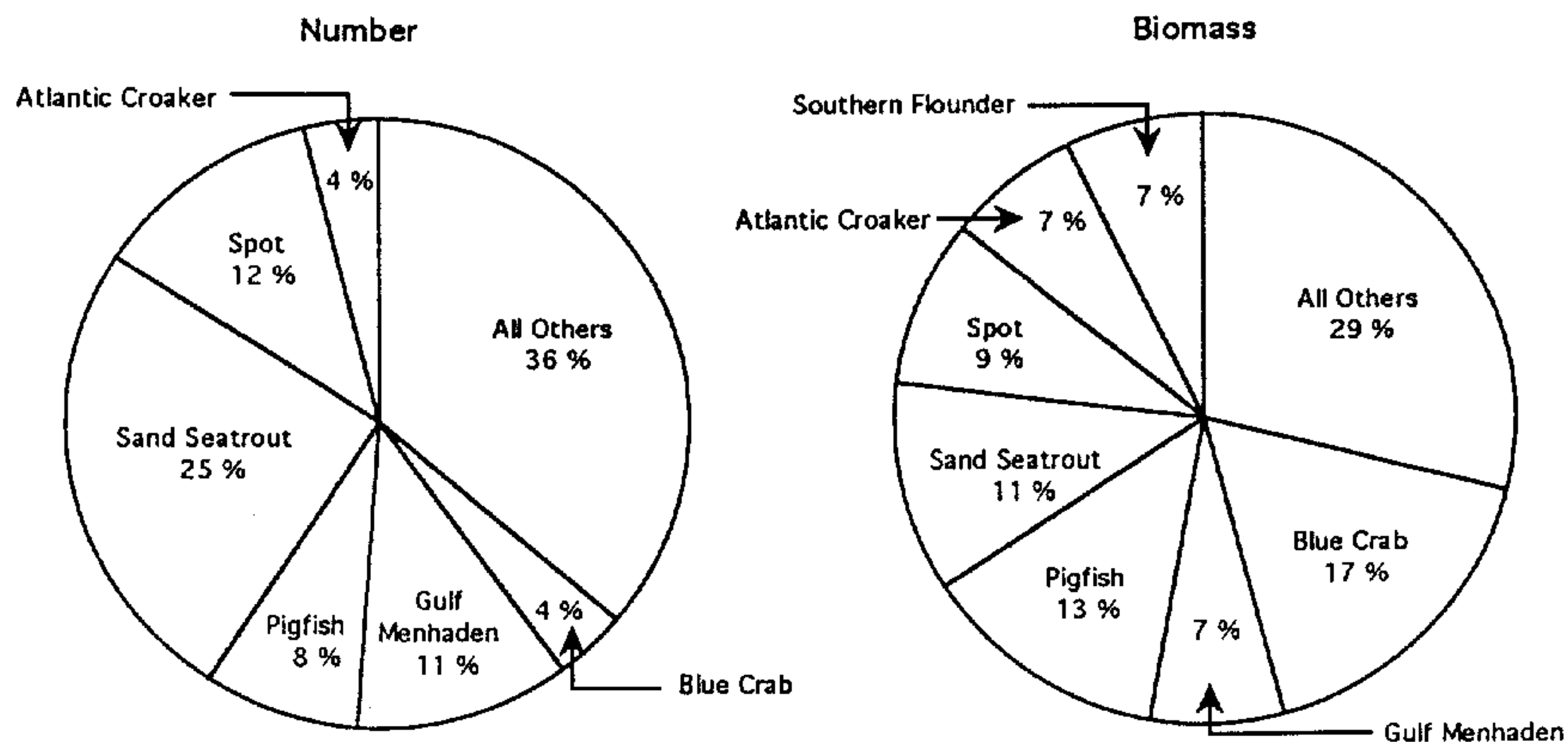


Figure 15. Percent of total bycatch (number and biomass) contributed by dominant fish and/or invertebrates during September and October 1981 (from Lamkin 1984).



November 1981



December 1981

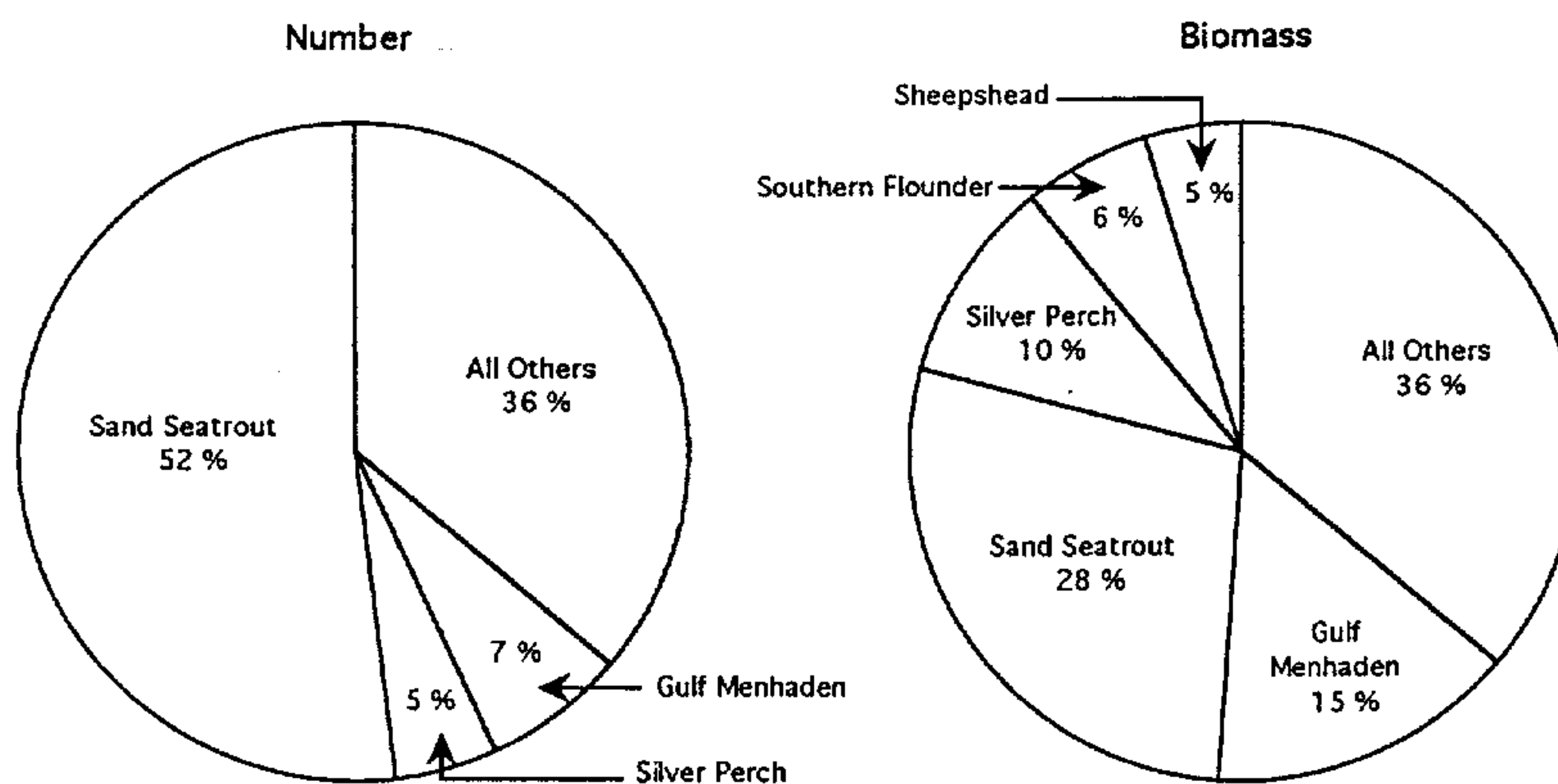
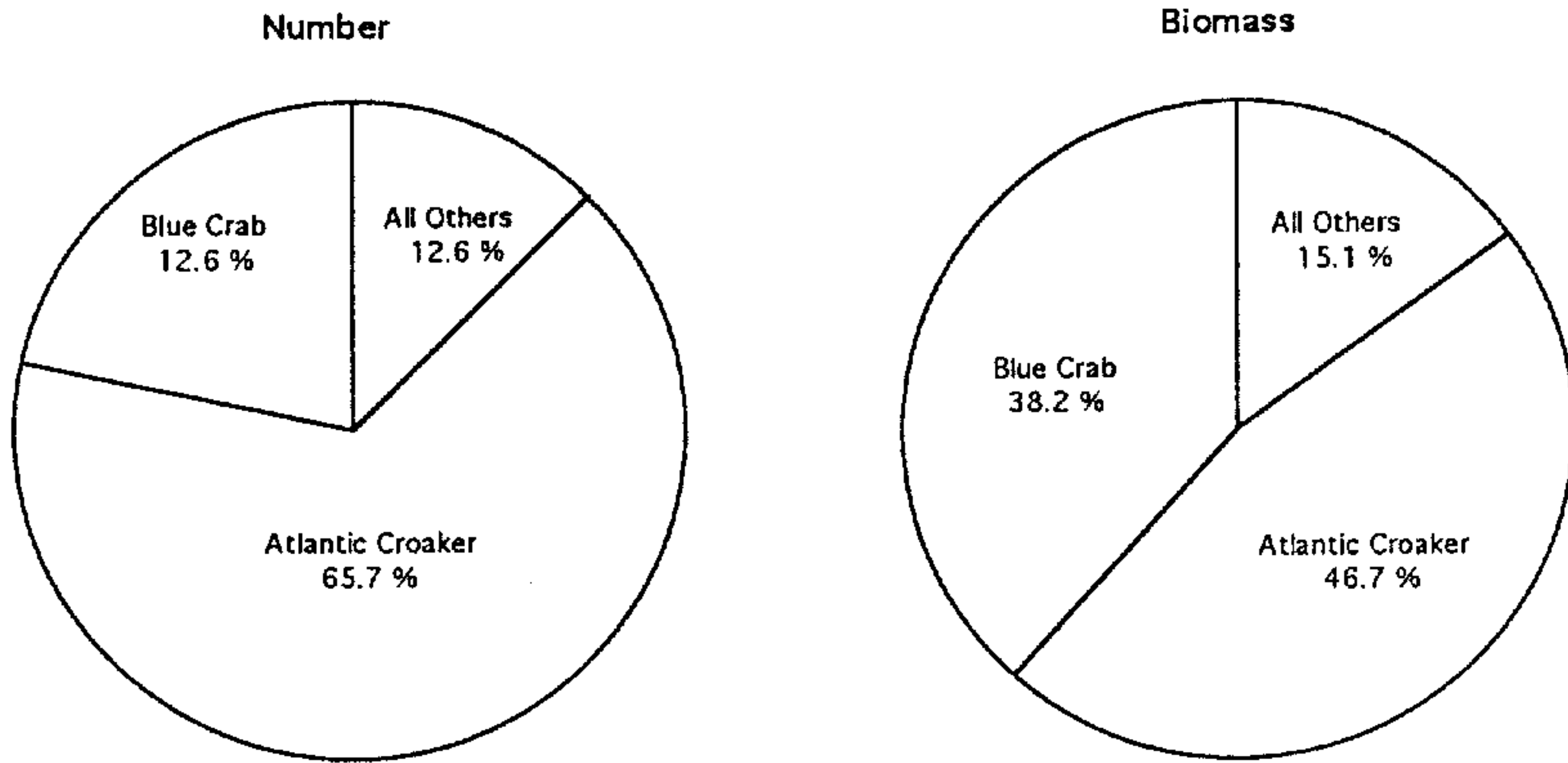


Figure 16. Percent of total bycatch (number and biomass) contributed by dominant fish and/or invertebrates during November and December 1981 (from Lamkin 1984).

May 1982



June 1982

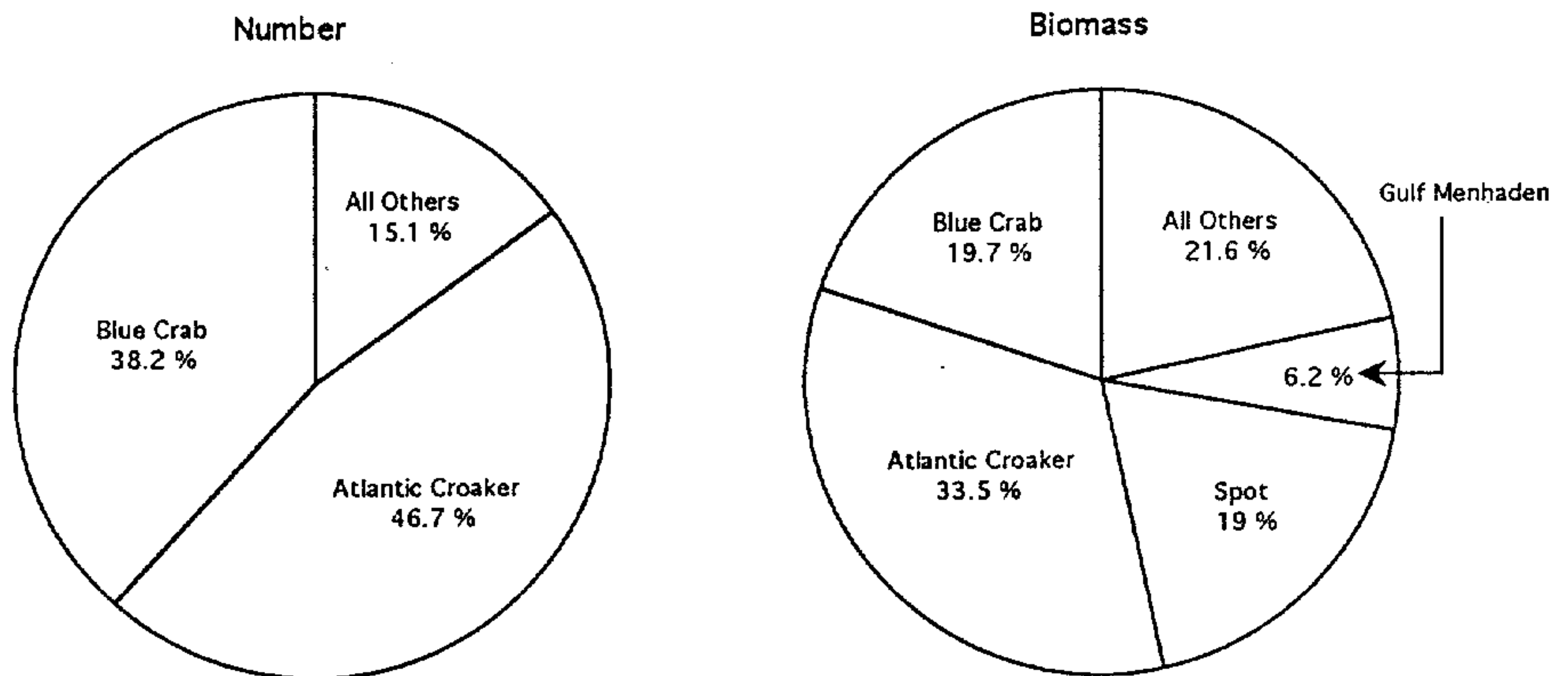


Figure 17. Percent of total bycatch (number and biomass) contributed by dominant fish and/or invertebrates during May and June 1982 (from Lamkin 1984).



**Table 1: Temperature and salinity in Galveston Bay sampling areas during 1981-82 (from Lamkin 1984).**

Sampling Area	Date	Temp. (°C)	Salinity (ppt)
West Bay	Jul-04	28.0	15
West Bay	Jul-08	26.0	14
West Bay	Jul-10	28.5	15
West Bay	Jul-16	30.0	22
Offatts Bayou	Jul-22	29.0	19
West Bay	Aug-01	29.0	20
West Bay	Aug-09	32.0	19
Offatts Bayou	Aug-19	32.0	18
Offatts Bayou	Aug-21	28.0	16
West Bay	Sep-02	26.0	16
West Bay	Sep-05	28.0	18
West Bay	Sep-08	28.0	19
West Bay	Sep-11	26.0	20
West Bay	Sep-18	25.0	16
West Bay	Sep-22	26.0	17
West Bay	Sep-29	27.0	19
West Bay	Oct-02	27.0	21
West Bay	Oct-09	25.0	22
West Bay	Oct-16	25.0	19
West Bay	Oct-27	18.5	15
West Bay	Oct-29	19.5	17
West Bay	Nov-06	21.0	22
West Bay	Nov-12	16.0	17
Lower Galveston Bay	Nov-19	16.5	17
Lower Galveston Bay	Dec-03	18.0	19
Lower Galveston Bay	Dec-11	18.5	20
Lower Galveston Bay	Dec-16	14.0	19
Lower Galveston Bay	Dec-31	11.0	16
West Bay	May-12	24.5	16
West Bay	May-17	26.0	16
West Bay	May-23	26.0	16
West Bay	Jun-01	28.0	17
West Bay	Jun-10	28.0	18
West Bay	Jun-24	30.0	16

**Table 2: Biomass and percentage of total catch for bait shrimp and bycatch taken from Galveston Bay during July 1981 through June 1982 (from Lamkin 1984).**

<b>Month</b>	<b>Shrimp Biomass (kg)</b>	<b>% of Catch</b>	<b>Bycatch (kg)</b>	<b>% of Catch</b>
Jul-81	166.6	81.3	38.4	18.7
Aug-81	44.0	57.6	32.5	42.4
Sep-81	124.4	58.0	90.2	42.0
Oct-81	166.3	80.2	41.0	19.8
Nov-81	46.2	67.4	22.3	32.6
Dec-81	115.6	83.1	23.5	16.9
May-82	178.5	73.6	64.1	26.4
Jun-82	190.5	81.0	44.7	19.0
Average	129.0	72.8	44.6	27.2

**Table 3: Monthly catch of southern flounder by commercial shrimp vessels in various areas of Galveston Bay (data from Matlock, 1982).**

<b>Month</b>	<b>Bay Area</b>	<b># of Southern Flounder</b>	<b>Flounder / Hr. ± 1 S.E.</b>	<b># Tows</b>	<b>Total Tow Time (Hrs.)</b>
April	Bastrop Bayou	2	1.0±1.0	9	2.1
May	Moses Lake; Galveston	3	0.7±0.5	6	4.4
June	Trinity	27	19.3±5.4	4	1.4
July	Galveston	0	0	2	1.8
August	Clear Lake	5	1.2±0.9	3	4
September	Galveston	0	0	3	1.5
October	Trinity	2	0.4±0.5	4	4.5
November	Clear Lake	0	0	3	3.6
April-November	All Areas	39	1.7±1.2	34	23.3



**Table 4: Baywide frequency of fishes, May-November 1984 (data from Bessette, 1985).**  
**Common names follow guidelines for taxonomic nomenclature set forth in**  
**American Fisheries Society Special Publications (Turgeon et al. 1988, Williams**  
**et al. 1988, Robins et al. 1991). Scientific names listed in Appendix 1.**

Species	# of Tows	Mean CPUE	Mean Wt. (grams)	Total Wt. (Kg.)
Atlantic Croaker	107	18.7	14.1	506.33
Spot	105	7.4	12.9	246.92
Gulf Menhaden	99	14.3	16.7	394.27
Sand Seatrout	92	2.3	20.9	73.55
Least Puffer	63	0.7	5.5	9.32
Pinfish	61	2.4	23.9	47.44
Threadfin Shad	58	2.8	16.0	69.57
Bay Whiff	57	0.6	6.5	13.58
Bay Anchovy	51	0.2	1.3	4.72
Atlantic Threadfin	48	0.9	14.6	9.29
Harhead Catfish	40	5.8	17.4	68.46
Cutlassfish	40	3.8	40.6	56.62
Inshore Lizardfish	38	1.3	25.8	23.48
Silver Perch	37	0.7	23.2	10.59
Striped Mullet	37	3.8	50.8	41.91
Gafftopsail Catfish	34	3.1	25.8	34.57
Gulf Butterfish	29	1.6	22.5	15.28
Bighead Searobin	29	0.8	37.9	7.38
Atlantic Spadefish	28	0.4	13.2	4.58
Southern Flounder	28	2.5	42.5	22.61
Harvestfish	25	2.2	58.2	15.17
Fringed Flounder	22	1.2	7.9	12.45
Pigfish	20	0.8	43.6	7.22
Spanish Mackerel	19	1.0	27.9	6.78
Crevale Jack	17	0.4	16.7	2.29
Atlantic Midshipman	15	0.2	17.6	1.04
Striped Anchovy	13	0.2	7.4	0.79
Gulf Toadfish	12	0.5	30.9	1.33
Black Drum	10	3.3	65.6	6.14
Lookdown	10	0.3	7.5	1.85
Atlantic Bumper	8	0.4	5.4	2.04
Blackcheek Tonguefish	8	0.3	10.5	1.20
Finescale Menhaden	7	0.9	48.4	1.18
Rock Sea Bass	7	0.7	28.5	2.60
Southern Kingfish	7	1.0	54.0	1.85
Spotted Seatrout	6	0.5	18.6	0.85

**Table 4 (continued):**

Species	# of Tows	Mean CPUE	Mean WT. (grams)	Total Wt. (Kg.)
Bluntnose Jack	6	0.3	14.5	0.64
Gulf Kingfish	6	1.5	77.5	2.56
Ocellated Flounder	5	1.3	67.9	1.67
Bluespotted Searobin	5	0.2	10.8	0.21
Hogchocker	4	0.3	38.6	0.47
Gizzard Shad	3	1.6	25.7	1.30
Silver Jenny	3	0.2	12.2	0.28
Leatherjack	3	0.1	8.5	0.08
Sheephead	2	0.5	43.3	0.35
Striped Burrfish	2	0.1	7.5	0.06
Atlantic Stingray	2	1.2	90.4	0.52
Scaled Sardine	2	0.1	4.2	0.05
Pygmy Filefish	2	0.1	2.9	0.07
Atlantic Thread Herring	2	0.2	5.8	0.13
Blackwing Searobin	3	0.2	17.1	0.24
Moonfish	2	0.0	2.0	0.02
Bearded Brotula	1	1.9	116.6	1.71
Ladyfish	1	0.5	40.7	0.11
Skilletfish	1	0.2	6.3	0.05
Highfin Goby	1	0.1	3.7	0.03
Freckled Blenny	1	0.2	18.2	0.08
Rough Silverside	1	0.1	5.6	0.03
Inland Silverside	1	0.0	3.1	0.01
Shrimp Eel	1	2.3	167.5	0.56
Bluefish	1	0.6	139.7	0.14
Florida Pompano	1	0.2	33.2	0.06

**Table 5: Baywide bycatch species percentage by biomass and number (data from Bessette, 1985). Common names follow guidelines set forth in American Fisheries Society standards (Turgeon et al. 1988, Williams et al. 1988, Robins et al. 1991). Scientific names are provided in Appendix 1.**

Common Name	Species Weight		Species Number	
	Total Kg.	%	Total	%
Lined Sole	0.22	0.01	67	0.1
Striped Anchovy	0.79	0.04	92	0.1
Bay Anchovy	4.72	0.25	4535	4.1
Ocellated Flounder	1.67	0.09	24	<0.1
Sheepshead	0.35	0.02	8	<0.1
Speckled Crab	0.88	0.05	17	<0.1
Hardhead Catfish	68.50	3.60	3650	3.3
Southern Stargazer	6.47	0.34	44	<0.1
Gafftopsail Catfish	34.57	1.84	1999	1.8
Silver Perch	10.59	0.56	410	0.4
Finescale Menhaden	1.18	0.06	34	<0.1
Gulf Menhaden	394.27	21.01	25544	23.2
Bearded Brotula	1.71	0.09	14	<0.1
Blue Crab	74.89	3.99	2154	2.0
Lesser Blue Crab	4.15	0.22	221	0.2
Creville Jack	2.29	0.12	109	0.1
Rock Sea Bass	2.60	0.14	75	0.1
Atlantic Spadefish	4.58	0.24	359	0.3
Striped Burrfish	0.06	<.01	7	<0.1
Atlantic Bumper	2.04	0.11	440	0.4
Bay Whiff	13.58	0.72	1392	1.3
Green Snapping Shrimp	0.04	<.01	26	<0.1
Sand Seatrout	73.55	3.92	4474	4.1
Spotted Seatrout	0.85	0.05	36	<0.1
Silver Seatrout	0.83	0.04	36	<0.1
Atlantic Stingray	0.52	0.03	5	<0.1
Gizzard Shad	1.30	0.07	44	<0.1
Threadfin Shad	69.57	3.71	3280	3.0
Ladyfish	0.11	0.01	2	<0.1
Fringed Flounder	12.45	0.66	1467	1.3
Silver Jenny	0.28	0.01	22	<0.1
Skilletfish	0.05	<.01	7	<0.1
Highfin Goby	0.03	<.01	7	<0.1
Scaled Sardine	0.05	<.01	10	<0.1
Bluntnose Jack	0.64	0.03	39	<0.1
Freckled Blenny	0.08	<.01	4	<0.1
Pinfish	47.44	2.53	2215	2.0



Table 5 (continued):

Common Name	Species Weight		Species Number	
	Total Kg.	%	Total	%
Spot	246.92	13.16	14857	13.5
Atlantic Brief Squid	47.89	2.55	3366	3.1
Rough Silverside	0.03	<.01	5	<0.1
Inland Silverside	0.01	<.01	2	<0.1
Southern Kingfish	1.85	0.10	28	<0.1
Gulf Kingfish	2.56	0.14	34	<0.1
Atlantic Croaker	506.33	26.98	29690	27.0
Pygmy Filefish	0.07	<.01	17	<0.1
Striped Mullet	41.91	2.23	840	0.8
Leatherjacket	0.08	<.01	12	<0.1
Shrimp Eel	0.56	0.03	3	<0.1
Atlantic Thread Herring	0.13	0.01	17	<0.1
Gulf Toadfish	1.33	0.07	31	<0.1
Pigfish	7.22	0.38	195	0.2
Southern Flounder	22.61	1.20	315	0.3
Gulf Butterfish	15.28	0.81	717	0.7
Harvestfish	15.17	0.81	230	0.2
Black Drum	6.14	0.33	85	0.1
Atlantic Threadfin	9.29	0.50	804	0.7
Bluefish	0.14	0.01	1	<0.1
Atlantic Midshipman	1.04	0.06	66	0.1
Iridescent Swimming Crab	1.19	0.06	103	0.1
Bluespotted Sea Robin	0.21	0.01	16	<0.1
Blackwing Sea Robin	0.24	0.01	12	<0.1
Bighead Sea Robin	7.38	0.39	194	0.2
Spanish Mackerel	6.78	0.36	191	0.2
Atlantic Moonfish	0.02	<.01	9	<0.1
Lookdown	1.85	0.10	345	0.3
Rock Shrimp	0.23	0.01	192	0.2
Least Puffer	9.32	0.50	1697	1.5
Mantis Shrimp	1.58	0.08	121	0.1
Star Drum	1.73	0.09	151	0.1
Blackcheek Tonguefish	1.20	0.06	78	0.1
Inshore Lizardfish	23.48	1.25	936	0.9
Florida Pompano	0.06	<.01	1	<0.1
Atlantic Cutlassfish	56.62	3.02	1733	1.6
Hogchoker	0.47	0.03	2	<0.1
All Species	1876.77	100.00	109983	100.0

**Table 6: Occurrence of fish by species and bay area (data from Besette 1985). Common names follow American Fisheries Society guidelines (Turgeon et al. 1988, Williams et al. 1988, Robins et al. 1991). Scientific names are provided in Appendix 1.**

Species	Tows (#)	Mean Wt. (grams)	Total Wt. (Kg.)	Percent By Weight	# Fish Caught	Percent By Number
<b>TRINITY BAY</b>						
Atlantic Croaker	20	10.4	112.22	42.71	6022	35.4
Gulf Menhaden	20	4.6	26.08	9.93	4692	27.6
Spot	20	9.7	35.93	13.67	1801	10.6
Hardhead Catfish	9	12.9	29.22	11.12	1039	6.1
Sand Seatrout	16	7.8	9.17	3.49	899	5.3
Least Puffer	15	4.9	4.05	1.54	671	3.9
Bay Whiff	6	6.5	6.94	2.64	482	2.8
Gafftopsail Catfish	6	14.0	5.09	1.94	475	2.8
Threadfin Shad	10	8.3	1.94	0.74	254	1.5
Southern Flounder	7	54.9	18.40	7.00	205	1.2
Bay Anchovy	5	0.7	0.09	<0.1	128	0.8
Pinfish	7	42.0	3.78	1.44	96	0.6
Black Drum	5	85.8	4.42	1.68	49	0.3
Striped Mullet	4	71.1	2.52	0.96	33	0.2
Spotted Seatrout	3	15.1	0.38	0.15	17	0.1
Atlantic Threadfin	5	21.3	0.38	0.15	17	0.1
Bighead Searobin	3	40.8	0.41	0.16	17	0.1
Gizzard Shad	2	21.5	0.33	0.13	16	<0.1
Atlantic Thread Herring	1	8.1	0.12	<0.1	14	<0.1
Striped Anchovy	3	6.7	0.10	<0.1	13	<0.1
Finescale Menhaden	2	8.5	0.12	<0.1	13	<0.1
Silver Perch	4	11.0	0.16	<0.1	12	<0.1
Atlantic Spadefish	2	6.0	0.04	<0.1	10	<0.1
Fringed Flounder	1	3.3	0.03	<0.1	9	<0.1
Lined Sole	1	1.0	0.01	<0.1	7	<0.1
Skilletfish	1	6.3	0.05	<0.1	7	<0.1
Leatherjack	1	1.7	0.01	<0.1	7	<0.1
Inshore Lizardfish	1	51.9	0.38	0.2	7	<0.1
Cutlassfish	1	30.0	0.19	<0.1	6	<0.1
Sheephead	1	54.8	0.14	<0.1	2	<0.1
Silver Jenny	1	19.1	0.03	<0.1	1	<0.1
Blackwing Searobin	1	1.1	0.00	<0.1	1	<0.1
Star Drum	1	19.3	0.03	<0.1	1	<0.1
Totals for All Species			262.77	100.0	17023	100.0



Table 6 (continued):

Species	Tows (#)	Mean Wt. (grams)	Total Wt. (Kg.)	Percent By Weight	# Fish Caught	Percent By Number
<b>UPPER GALVESTON BAY</b>						
Atlantic Croaker	16	10.6	138.44	53.9	6789	39.3
Gulf Menhaden	16	6.5	50.93	19.8	6323	36.6
Hardhead Catfish	9	40.1	24.29	9.5	1428	8.3
Spot	16	12.4	12.78	5.0	995	5.8
Sand Seatrout	14	26.9	12.56	4.9	444	2.6
Least Puffer	14	3.0	1.15	0.4	349	2.0
Gafftopsail Catfish	7	22.7	2.23	0.9	218	1.3
Threadfin Shad	8	17.6	3.49	1.4	192	1.1
Atlantic Threadfin	10	14.1	1.67	0.6	136	0.8
Bay Whiff	8	6.8	0.86	0.3	130	0.8
Bay Anchovy	7	1.2	0.10	<0.1	100	0.6
Pinfish	1	30.1	0.92	0.4	30	0.2
Harvestfish	3	127.8	3.05	1.2	29	0.2
Atlantic Spadefish	1	11.9	0.18	<0.1	15	<0.1
Inshore Lizardfish	4	18.0	0.33	0.1	15	<0.1
Finescale Menhaden	3	45.1	0.69	0.3	13	<0.1
Black Drum	1	60.5	0.62	0.2	10	<0.1
Striped Anchovy	2	7.7	0.07	<0.1	8	<0.1
Southern Kingfish	1	110.9	0.88	0.3	7	<0.1
Bighead Searobin	1	8.6	0.07	<0.1	7	<0.1
Lined Sole	1	0.9	0.01	<0.1	6	<0.1
Gulf Toadfish	1	56.3	0.38	0.1	6	<0.1
Silver Perch	1	7.7	0.04	<0.1	5	<0.1
Spotted Seatrout	1	21.5	0.07	<0.1	3	<0.1
Atlantic Stingray	1	81.3	0.28	0.1	3	<0.1
Southern Flounder	1	84.3	0.29	0.1	3	<0.1
Blackcheek Tonguefish	1	8.7	0.03	<0.1	3	<0.1
Southern Stargazer	1	85.7	0.22	<0.1	2	<0.1
Crevalle Jack	1	3.1	0.01	<0.1	2	<0.1
Ladyfish	1	40.7	0.11	<0.1	2	<0.1
Fringed Flounder	1	2.0	0.01	<0.1	2	<0.1
Striped Mullet	1	20.2	0.05	<0.1	2	<0.1
Spanish Mackerel	1	47.9	0.12	<0.1	2	<0.1
Atlantic Midshipman	1	25.0	0.05	<0.1	1	<0.1
Totals for All Species			256.95	100.0	17280	100.0

Table 6 (continued):

Species	Tows (#)	Mean Wt. (grams)	Total Wt. (Kg.)	Percent By Weight	# Fish Caught	Percent By Number
<b>WEST BAY</b>						
Atlantic Croaker	16	16.9	37.25	30.9	3064	39.6
Spot	15	11.4	12.22	10.1	1296	16.7
Gulf Menhaden	9	57.2	13.87	11.5	820	10.6
Gafftopsail Catfish	6	17.9	12.65	10.5	688	8.9
Pinfish	13	15.7	7.34	6.1	599	7.7
Cutlassfish	11	45.5	17.50	14.5	455	5.9
Sand Seatrout	12	15.4	3.59	3.0	197	2.5
Atlantic Spadefish	11	18.9	2.40	2.0	127	1.6
Pigfish	9	30.3	2.53	2.1	110	1.4
Bay Whiff	8	8.9	0.53	0.4	59	0.8
Silver Perch	7	22.8	0.98	0.8	49	0.6
Bay Anchovy	5	1.6	0.07	<0.1	43	0.6
Gulf Butterfish	6	21.9	0.99	0.8	38	0.5
Least Puffer	8	7.7	0.24	0.2	34	0.4
Atlantic Threadfin	4	8.5	0.29	0.2	30	0.4
Harvestfish	4	83.5	2.81	2.3	25	0.3
Atlantic Midshipman	8	11.9	0.23	0.2	23	0.3
Spanish Mackerel	3	50.0	1.02	0.8	12	0.2
Gulf Toadfish	7	25.8	0.48	0.4	11	0.1
Inshore Lizardfish	3	43.3	0.67	0.6	11	0.1
Threadfin Shad	3	19.7	0.22	0.2	9	0.1
Southern Flounder	4	31.4	0.42	0.3	9	0.1
Striped Mullet	2	120.0	0.89	0.7	8	0.1
Fringed Flounder	3	9.1	0.07	<0.1	6	<0.1
Bighead Searobin	4	64.4	0.78	0.6	5	<0.1
Hardhead Catfish	3	25.9	0.15	0.1	4	<0.1
Lined Sole	1	2.2	0.01	<0.1	3	<0.1
Black Drum	1	42.4	0.15	0.1	3	<0.1
Blackcheek Tonguefish	2	1.9	0.00	<0.1	1	<0.1
Hogchoker	1	105.7	0.16	<0.1	1	<0.1
Lookdown	1	0.0	0.00	<0.1	0	<0.1
Totals for All Species			120.53	100.0	7740	100.5

**Table 6 (continued):**

Species	Tows (#)	Mean Wt. (grams)	Total Wt. (Kg.)	Percent By Weight	# Fish Caught	Percent By Number
<b>LOWER GALVESTON BAY</b>						
Atlantic Croaker	21	22.6	123.88	24.7	4630	20.8
Gulf Menhaden	21	19.8	126.58	25.2	3504	15.7
Spot	20	16.6	35.54	7.1	1852	8.3
Sand Seatrout	21	30.6	30.14	6.0	1534	6.9
Bay Anchovy	11	1.3	1.66	0.3	1519	6.8
Threadfin Shad	14	15.1	40.00	8.0	1473	6.6
Fringed Flounder	11	7.9	9.23	1.8	1117	5.0
Cutlassfish	13	37.9	25.31	5.0	939	4.2
Inshore Lizardfish	15	22.7	18.40	3.7	765	3.4
Pinfish	15	25.5	15.56	3.1	748	3.4
Bay Whiff	17	7.7	4.34	0.9	552	2.5
Hardhead Catfish	9	9.6	12.67	2.5	511	2.3
Atlantic Bumper	5	7.3	1.93	0.4	388	1.7
Atlantic Threadfin	12	21.7	5.26	1.0	379	1.7
Gulf Butterfish	12	23.6	7.50	1.5	370	1.7
Least Puffer	11	5.3	2.04	0.4	357	1.6
Lookdown	4	11.7	1.35	0.3	251	1.1
Silver Perch	7	25.2	4.24	0.8	168	0.8
Star Drum	2	11.0	1.53	0.3	143	0.6
Spanish Mackerel	6	26.7	4.02	0.8	121	0.5
Atlantic Spadefish	8	12.3	0.86	0.2	98	0.4
Rock Sea Bass	7	28.5	2.60	0.5	75	0.3
Striped Mullet	3	52.0	5.76	1.1	74	0.3
Harvestfish	7	19.3	1.33	0.3	73	0.3
Bighead Searobin	7	30.9	2.07	0.4	60	0.3
Lined Sole	1	3.8	0.20	<0.1	51	0.2
Blackcheek Tonguefish	2	16.4	0.84	0.2	50	0.2
Striped Anchovy	5	8.2	0.46	<0.1	46	0.2
Southern Stargazer	3	105.1	6.25	1.2	42	0.2
Crevalle Jack	5	15.9	0.62	0.1	42	0.2
Silver Seatrout	3	21.7	0.75	0.2	34	0.2
Bluntnose Jack	4	19.7	0.61	0.1	34	0.2
Gafftopsail Catfish	4	32.0	1.02	0.2	29	0.1
Atlantic Midshipman	3	23.7	0.45	<0.1	21	<0.1
Ocellated Flounder	4	61.8	1.15	0.2	19	<0.1
Pigfish	5	44.5	0.71	0.1	19	<0.1
Hogchoker	3	16.2	0.31	<0.1	19	<0.1
Gulf Toadfish	4	33.5	0.46	<0.1	14	<0.1
Southern Flounder	5	74.4	1.28	0.3	14	<0.1
Spotted Seatrout	1	23.9	0.31	<0.1	12	<0.1
Gulf Kingfish	1	35.0	0.45	<0.1	12	<0.1
Pygmy Filefish	1	4.7	0.06	<0.1	12	<0.1
Bluespotted Searobin	4	11.7	0.17	<0.1	12	<0.1



**Table 6 (continued):**

Species	Tows (#)	Mean Wt. (grams)	Total Wt. (Kg.)	Percent By Weight	# Fish Caught	Percent By Number
<b>LOWER GALVESTON BAY (cont.)</b>						
Southern Kingfish	4	46.0	0.60	0.1	11	<0.1
Finescale Menhaden	1	17.4	0.13	<0.1	7	<0.1
Striped Burrfish	2	7.5	0.06	<0.1	7	<0.1
Highfin Goby	1	3.7	0.03	<0.1	7	<0.1
Sheephead	1	31.9	0.21	<0.1	6	<0.1
Scaled Sardine	1	5.4	0.03	<0.1	6	<0.1
Rough Silverside	1	5.6	0.03	<0.1	5	<0.1
Silver Jenny	1	5.3	0.03	<0.1	4	<0.1
Freckled Blenny	1	18.2	0.08	<0.1	4	<0.1
Blackwing Searobin	1	46.5	0.21	<0.1	4	<0.1
Moonfish	1	2.9	0.01	<0.1	4	<0.1
Leatherjack	1	15.0	0.05	<0.1	3	<0.1
Atlantic Thread Herring	1	3.5	0.01	<0.1	3	<0.1
Atlantic Stingray	1	99.5	0.25	<0.1	2	<0.1
Florida Pompano	1	33.2	0.06	<0.1	1	<0.1
Totals for All Species			501.70	100.0	22257	100.0

Table 6 (continued):

Species	Tows (#)	Mean Wt. (grams)	Total Wt. (Kg.)	Percent By Weight	# Fish Caught	Percent By Number
<b>FAR WEST AND CHOCOLATE BAY</b>						
Spot	22	15.6	131.26	30.1	6241	25.4
Gulf Menhaden	22	18.8	104.40	24.0	5917	24.0
Atlantic Croaker	22	10.8	65.28	15.0	5163	21.0
Bay Anchovy	16	1.5	1.85	0.4	1619	6.6
Sand Seatrout	19	25.1	16.82	3.9	1285	5.2
Threadfin Shad	13	19.3	18.27	4.2	915	3.7
Pinfish	15	20.5	16.50	3.8	645	2.6
Gafftopsail Catfish	8	38.5	12.10	2.8	517	2.1
Striped Mullet	18	44.3	18.32	4.2	396	1.6
Cutlassfish	11	31.5	10.56	2.4	254	1.0
Gulf Butterfish	7	20.8	4.20	1.0	196	0.8
Silver Perch	17	26.7	5.15	1.2	174	0.7
Least Puffer	6	13.5	1.21	0.3	126	0.5
Atlantic Threadfin	11	10.2	0.87	0.2	111	0.5
Bay Whiff	11	4.6	0.64	0.1	106	0.4
Fringed Flounder	2	7.1	0.68	0.2	98	0.4
Hardhead Catfish	5	3.4	0.41	<0.1	95	0.4
Bighead Searobin	10	30.6	2.32	0.5	90	0.4
Harvestfish	7	84.0	7.92	1.8	89	0.4
Lookdown	3	5.4	0.42	0.1	81	0.3
Southern Flounder	10	22.1	2.22	0.5	79	0.3
Inshore Lizardfish	8	31.1	2.36	0.5	67	0.3
Atlantic Spadefish	4	7.5	0.64	0.1	55	0.2
Pigfish	5	50.4	2.41	0.6	54	0.2
Spanish Mackerel	5	19.5	1.47	0.3	48	0.2
Crevalle Jack	7	21.7	1.37	0.3	44	0.2
Gulf Kingfish	5	86.0	2.11	0.5	22	<0.1
Blackcheek Tonguefish	2	9.9	0.29	<0.1	22	<0.1
Atlantic Midshipman	3	24.1	0.31	<0.1	21	<0.1
Atlantic Bumper	1	4.0	0.07	<0.1	17	<0.1
Silver Jenny	1	12.3	0.22	<0.1	17	<0.1
Striped Anchovy	2	6.2	0.08	<0.1	14	<0.1
Bearded brotula	1	116.6	1.71	0.4	14	<0.1
Moonfish	1	1.1	0.01	<0.1	5	<0.1
Southern Kingfish	1	68.8	0.28	<0.1	4	<0.1
Bluespotted Searobin	1	7.5	0.04	<0.1	4	<0.1
Shrimp Eel	1	167.5	0.56	0.1	3	<0.1
Silver Seatrout	1	24.5	0.07	<0.1	2	<0.1
Finescale Menhaden	1	169.0	0.23	<0.1	1	<0.1
Totals for All Species			435.63	100.0	24611	100.0

Table 6 (continued):

Species	Tows (#)	Mean Wt. (grams)	Total Wt. (Kg.)	Percent By Weight	# Fish Caught	Percent By Number
<b>EAST BAY</b>						
Gulf Menhaden	11	10.2	72.40	43.0	4288	28.8
Atlantic Croaker	12	11.9	29.25	17.4	4022	27.0
Spot	12	9.4	19.19	11.4	2672	18.0
Bay Anchovy	7	0.8	0.95	0.6	1126	7.6
Hardhead Catfish	5	7.4	1.72	1.0	573	3.9
Threadfin Shad	10	18.1	5.64	3.3	437	2.9
Striped Mullet	9	42.3	14.37	8.5	327	2.2
Fringed Flounder	4	10.1	2.44	1.4	235	1.6
Least Puffer	9	3.0	0.62	0.4	160	1.1
Atlantic Threadfin	6	7.7	0.82	0.5	131	0.9
Sand Seatrout	10	11.7	1.27	0.8	115	0.8
Gulf Butterfish	4	23.1	2.58	1.5	113	0.8
Pinfish	10	23.9	3.35	2.0	97	0.7
Cutlassfish	4	63.8	3.07	1.8	79	0.5
Gafftopsail Catfish	3	30.1	1.49	0.9	72	0.5
Inshore Lizardfish	7	20.0	1.33	0.8	71	0.5
Bay Whiff	7	3.9	0.28	0.2	63	0.4
Atlantic Spadefish	2	5.7	0.46	0.3	54	0.4
Atlantic Bumper	2	1.1	0.04	<0.1	35	0.2
Gizzard Shad	1	34.1	0.96	0.6	28	0.2
Black Drum	3	41.3	0.95	0.6	23	0.2
Crevalle Jack	4	12.4	0.29	0.2	21	0.1
Bighead Searobin	4	47.0	1.74	1.0	15	0.1
Harvestfish	4	3.6	0.06	<0.1	14	<0.1
Lookdown	2	6.2	0.08	<0.1	13	<0.1
Pigfish	1	125.3	1.57	0.9	12	<0.1
Striped Anchovy	1	7.0	0.08	<0.1	11	<0.1
Spanish Mackerel	4	18.5	0.15	<0.1	8	<0.1
Blackwing Searobin	1	3.7	0.03	<0.1	7	<0.1
Star Drum	1	23.9	0.17	0.1	7	<0.1
Southern Kingfish	1	14.5	0.09	<0.1	6	<0.1
Ocellated Flounder	1	92.5	0.51	0.3	5	<0.1
Bluntnose Jack	2	4.2	0.02	<0.1	5	<0.1
Pygmy Filefish	1	1.1	0.01	<0.1	5	<0.1
Southern Flounder	1	2.5	0.01	<0.1	5	<0.1
Spotted Seatrout	1	20.8	0.09	<0.1	4	<0.1
Scaled Sardine	1	2.9	0.01	<0.1	4	<0.1
Silver Perch	1	17.3	0.04	<0.1	2	<0.1
Inland Silverside	1	3.1	0.01	<0.1	2	<0.1
Leatherjack	1	8.7	0.02	<0.1	2	<0.1
Blackcheek Tonguefish	1	18.8	0.04	<0.1	2	<0.1
Inland Silverside	1	139.7	0.14	<0.1	1	<0.1
Totals for All Species	12		168.35	100.0	14872	100.0



**Table 7: Baywide frequency of invertebrates, May-November 1984 (data from Bessette 1985).**

Species	# of Tows	Mean CPUE	Mean WT. (grams)	Total Wt. (Kg.)
Blue Crab	56	7.50	53.5	74.90
Atlantic Brief Squid	47	2.70	15.9	47.90
Mantis Shrimp	8	0.38	12.0	1.60
Iridescent Swimming Crab	8	0.38	12.9	1.20
Lesser Blue Crab	7	1.00	24.7	4.20
Rock Shrimp	7	0.07	1.1	0.20
<i>Crangon normanni</i> <sup>2</sup>	2	0.05	1.8	0.04
Speckled Swimming Crab	1	1.10	51.5	0.88

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<sup>2</sup> Bessette (1986) reported the occurrence of a crangon shrimp (*Crangon normanni*) which is presumably an erroneous identification or classification of the Green Snapping Shrimp (*Alpheus normanni*). No listing is available for *C. normanni* in Williams et al. (1988) which is used as the primary reference for taxonomic nomenclature of crustaceans in this study.

**Table 8: Average monthly shrimp:fish ratios and associated 95% confidence intervals ( $\pm$  t.05 standard deviation) calculated from log (ln) transformed data (from Lamkin 1984).**

<b>Month</b>	<b>-t.05</b>	<b>Mean Ratio</b>	<b>+t.05</b>	<b>Minimum Ratio</b>	<b>Maximum Ratio</b>	<b>n</b>
Jul-81	3.3	6.4:1	12.2	1.2:1	37.8:1	10
Aug-81	1.0	2.1:1	4.6	0.5:1	4.8:1	7
Sep-81	1.0	1.8:1	3.1	0.1:1	9.9:1	14
Oct-81	1.9	4.1:1	8.5	3.1:1	9.8:1	8
Nov-81	1.0	2.4:1	5.6	0.8:1	10.1:1	6
Dec-81	0.7	1.5:1	3.3	1.71:1	13.1:1	7
May-82	1.9	5.2:1	14.6	2.1:1	11.2:1	4
Jun-82	1.7	3.9:1	9.1	1.5:1	8.6:1	6
Overall	2.5	3.2:1	4.2			62

## IV. CHARACTERIZATION OF TRAWL BYCATCH DURING 1992

### METHODS

#### *Sampling Design*

The sampling design was developed from analysis of NMFS shrimp effort and landings data in Galveston Bay (Figures 18-20) and from a preliminary review of the two historical bycatch studies conducted in Galveston Bay (Lamkin 1984, Bessette 1985). Shrimp vessels (both commercial and bait shrimp) were contracted to provide samples from trawling operations for each of three fishing 'zones' within Galveston Bay.

The three fishing zones within the bay were defined by prior biotic and salinity patterns as well as shrimping effort levels: 1) Trinity Bay, 2) Upper Galveston and East Bays, and 3) Lower Galveston and West Bays (Figure 21). A total of 25 vessels (owners and/or captains) agreed to participate; 19 of these were randomly selected during data collection efforts between March and November 1992. Two vessels were utilized in Trinity Bay, and five in Lower /West bay areas; the rest were located throughout Upper & East Galveston Bay.

Vessels fished in zones where the captain normally fished to reduce variation caused by fishing in unfamiliar areas. Captains were paid on a per sample basis (up to \$200 per sampling trip) and sampling days and vessels were randomly selected each month. It was recommended that vessel captains fish an area within the zone where maximum shrimping effort was expected. This helped ensure that samples were representative of the overall fishing effort contributed by most members of the shrimp fleet in any given Galveston Bay area. Samples were collected by on-board observers during normal fishing operations.

The formula  $N=(4s^2)/L^2$  was used to estimate number of samples needed to calculate actual mean bycatch CPUE (Snedecor and Cochran 1967). Where:

- N = sample size,
- $s^2$  = approximation of variance associated with mean bycatch per tow,
- L = the tolerated accuracy of the calculated mean.

The tolerated accuracy of the calculated mean (L) used in this case was  $\pm 6.8$  kg. The multiplier 4 used in the equation is the z-value for the 95% level of significance ( $\alpha = 0.05$ ). Approximation of sample variance associated with bycatch was obtained from review of previously unpublished research of a Galveston Bay trawling study (Bessette 1985). Sample size estimates were calculated for a range of L values from 0 to 70 lb/hr in 5 lb/hr increments. For each of the three 'fishing zones', an accuracy of  $\pm 15$  lb/hr (L) was the point of exponential increase for the number of required samples (Figure 22). To meet this desired level of accuracy, at least 100 samples



were required from Trinity Bay, 115 in Upper Galveston and East Bays, and 61 samples in Lower Galveston and West Bays (total = 276 samples over a 1 year period). However, the allocation of samples to be taken in each fishing zone was flexible so that changes in effort patterns due to extenuating circumstances (i.e., low catch rates in an area causing a shift in fishing effort) would also result in a corresponding shift in the allocation of samples collected.

Based on historical data (Figures 18-20), 90% of the samples (tows) should be collected during May-November (peak catch and effort period) and 10% of samples during December-April (off season). Although only 3% of the shrimping effort occurs during December-April (historically), many important finfish species are abundant in Galveston Bay. Thus, up to 10% of the samples were to be taken during December-April. Projected sampling intensities for the three fishing zones are presented in Table 9. At least 8 sampling days each month were required during May-November, with 12 days total for December-April. Whereas a minimum of 63 total sampling days is indicated, we budgeted 75 days due to uncertainty in number of available samples per day (4-5 per day estimated). During both December-April and May-November, sampling dates for each bay area (fishing zone) were randomly selected for each month (or period), subject to vessel operations and bay conditions. The timing and duration of shrimping operations in estuarine systems and Texas territorial waters is controlled by Texas shrimp fishery regulations; a review of these regulations is provided in Appendix 2.

### ***Sampling Methodology***

Field operations aboard fishing vessels included, but were not limited to, the following measurements: 1) Net type, headrope length, mesh size of trawl nets, 2) location and duration of tow, 3) weight of the total catch, 4) weight of the subsample, 5) identification, length measurement, and weight of all large fishes, particularly recreational species, and 6) surface temperature and salinity at the end of each tow sampled. Bottom temperature and salinity measurements were recorded at the end of each tow when possible and usually at least once in each general area where tows were made. An example of the field data sheet (and sampling instructions) is provided in Appendix 3. A First-Mate<sup>TM</sup> electronic scale (1-2000 lb. capacity, Hydroscale, Inc., Perth Amboy, NJ) attached to trawl rigging was used to weigh total catch in the net upon completion of the tow. The net was weighed prior to, and immediately following release of the catch; total catch weight was determined by subtraction of initial and final net weights. Salinity was measured with a hand held, temperature-compensated refractometer (Argent Laboratories, Redmond, Washington)<sup>3</sup>. Trawl locations were determined using Ensign<sup>TM</sup> or Trans-pak<sup>TM</sup> GPS units (Global Positioning System; Trimble Navigation, Marine Products Division, Sunnyvale, CA). Refractometers and scales were tested and calibrated prior to initiating sampling.

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3 Use of commercial or trade names does not imply approval, recommendation or endorsement of any proprietary product or material. No reference shall be made to the authors, or to this publication in any advertising or sales promotion which would indicate or imply that authors approve, recommend or endorse any proprietary product or material mentioned herein.



Accuracy and precision of refractometers and scales were arbitrarily tested at irregular intervals throughout the duration of the study; recalibration of these items was completed as necessary.

After weighing the catch at the end of a trawl tow, catch was dumped into culling boxes (plywood enclosures with flow-through seawater) or onto the deck, depending on the catch sorting method used by individual fishermen. If a culling box was utilized, a dip net was used to mix the catch and remove individual, presumably random, subsamples (up to 25 lb). If catch was dumped on the deck of a vessel, the subsample was randomly removed using a shovel or scoop. Individual samples were placed in canvas bags, labeled and maintained on ice. Samples were returned for laboratory processing where the following measurements were recorded: 1) total fish weight, total shrimp weight, and total weight of other items (crabs, squid, debris, etc.) in the sample, 2) total weight and total number by species, 3) length of up to 25 individuals of each species in each trawl catch. Items (finfish or debris) too large to fit in sample bags were identified, measured and recorded on data sheets in the field.

### ***Data Analysis***

All data were standardized according to tow duration (hr) and net size prior to data analysis. Data are reported in terms of CPUE by number and weight of individuals captured for two net sizes because of legal gear restrictions. Trawls for commercial vessels are limited to 16.5-m (54') in length (including doors) during the spring open season (May 15 - July 15). As a result, the most common net during this period maintains a headrope length of 9.8-m (32'). However, during the fall open season (August 15 - December 15), vessels operating under a commercial bay license may use nets up to 30-m (95') in length including doors (~22-m or 72' headrope length). All bait shrimp vessels are limited to a 16.5-m long net (with doors) throughout the year. The 9.8-m net (headrope length) was maintained by all vessels used prior to the fall open season. The mean size of net (headrope length) sampled throughout the fall season is 13.4-m, thus this value is used to express CPUE data. Consequently, bycatch data were standardized and are expressed as number and weight (kg) per hour towed for a 9.8-m net during March - July, or a 13.4-m (44') net during August - November.

Large items (finfish or debris) which were recorded on field station sheets were not included in the individual analyses in this report. The determination of whether a large item would be represented in the subsample or should be recorded on the field sheets was based on subjective opinion of on-board observers. Therefore, data analyses will only include data from organisms which are represented in the tow subsamples. Other large items listed on field sheets are reported separately in this document.

Data were compiled and maintained in Dbase III+ (IBM/PC) and Excel 4.0 (MacIntosh) software packages. Electronic data files were proofed and compared with raw data sheets to verify accuracy and completeness. Data analyses were performed using Systat 5.1 (Systat, Inc., Evanston, IL) statistical software for MacIntosh computers. Two copies of electronic data files and raw data sheets are



maintained for archival purposes at the NMFS Laboratory (Galveston). Additionally, two copies of electronic data are provided to the U.S. EPA contractor (Tetrattech, Inc., Seattle, WA) for archival in ODES system (Ocean Data Evaluation System). Copies of electronic data files and raw data sheets are provided to GBNEP for archival purposes.

## RESULTS AND DISCUSSION

Most vessels which participated in this study operated under both live-bait and commercial shrimping licenses. Of the 19 vessels, 6 were mostly used for live-bait purposes, 10 were primarily commercial shrimping vessels, and 3 spent almost equal time shrimping for both live-bait and commercial sale of shrimp. Between 20 March and 30 November, 296 tow samples were collected; however, only 291 tows were used in analyses (Table 10) due to problems encountered with sample collection (i.e., electronic scale failure, station locations not recorded, etc). Spatial distribution of samples collected is depicted in Figure 23; monthly sampling intensity is presented in Table 10 and Figure 24. High levels of freshwater inflow during March - June reduced shrimp catch and effort in Trinity Bay and the uppermost reaches of Galveston Bay. These conditions made it extremely difficult to schedule vessels for trips in Trinity Bay during those months. Many vessels which traditionally fished that area reportedly moved to locations further south on the Texas coast, primarily Matagorda Bay and the area around Port O'Connor and Palacios. The reduction of effort in Trinity Bay to negligible levels during June - September was also verified by anecdotal reports of TPWD law enforcement officers (H. Gonzalez, TPWD Enforcement, personal communication). Consequently, samples collected in Trinity Bay during June-September were limited to a few tows sampled during August (Figure 24).

Standardized data (CPUE) for individual species are provided in Tables 10-12. These include only those species which were represented in tow subsamples. Several noteworthy or large species which were otherwise not represented in tow subsamples are listed in Table 14. Overall, 134 species were captured throughout Galveston Bay in 291 tows: 85 finfish species, 3 penaeid shrimp species and 46 invertebrate species. Also, 17 unidentified items where individuals were not positively identified to species are included in Table 14. For most of these, positive identification was difficult because of damages incurred during trawling, handling, freezer storage or subsequent thawing of samples prior to processing.

Total CPUE, by number and biomass for each species, as well as presence or absence of each species are provided in Table 11. "Unidentified jellyfish" includes individuals of several species, primarily comb jellies (*Beroe* spp.), sea nettles or stinging jellyfish (*Chrysaora quinquecirrha*), cannonball jellyfish (*Stomolophus meleagris*) and moon jelly (*Aurelia aurelia*). Items which could be weighed but not counted (i.e., debris, clumps of oysters, jellyfish pieces, seaweed, etc.) were given zero values for CPUE by number (Table 11). Thus, it is important to review all data for differences in CPUE in terms of numbers and biomass.



About 10 to 15 species accounted for most organisms captured, in terms of number of tows they occurred in and total CPUE by number and biomass. These include: white and brown shrimp, Atlantic croaker, gulf menhaden, spot, sand seatrout, cutlassfish, hardhead catfish, bay anchovy, Atlantic brief squid, blue crab, gafftopsail catfish, blue catfish and wedge rangia clams. Debris items also occurred relatively frequently; debris was found in 206 of 291 samples and ranked 15th among all items caught (biomass CPUE). The debris category includes manmade paper or plastic items, pieces of wood, remnants of tree branches or other miscellaneous debris.

With the exception of Atlantic croaker and sand seatrout, relatively few fish species of special interest were captured in shrimp trawls. Based on numbers and biomass, spotted seatrout ranked 42nd (Table 11, numerical CPUE) and 35th (biomass CPUE); red drum ranked 48th and 102nd; southern flounder placed 56th and 32nd respectively; black drum ranked 69th by number and 34th by weight (CPUE). Most southern flounder were captured during fall (following the onset of a cold front) in trawls in deeper water (including the Galveston Intracoastal Waterway). Many of the flounder captured were taken in West Bay. Flounder (and other fish) migrate out of the bay in large numbers when water temperatures decrease below optimum levels; this offshore migration is primarily preceded by movement into deeper waters within the bay system. Juvenile Spanish mackerel, another species of special interest, were also taken within the estuary. Most Spanish mackerel were taken in the upper bay 'fishing zone' which included East Bay. Spanish mackerel ranked 41st based on numerical CPUE and 38th based on biomass.

Tables 11 and 12 provide monthly and spatial (by area) data for individual species; more species were found during the months of June and July (Table 12, Figure 25). The upper bay area provided the most diversity of bycatch species (Table 13, Figure 25). One possible reason is the upper bay 'fishing zone' may provide habitat for large populations of oligohaline (freshwater), polyhaline (brackish) and euryhaline (marine) species depending upon magnitude of freshwater inflow. Additionally, more samples were collected from the upper bay area (Figures 22-24) thus increasing the possibility of capturing more uncommon species. Size-frequency distributions for select species are provided in Figures 26-36. Total lengths are provided for finfish while tail lengths are used for brown and white shrimp. Generally, smaller individuals were captured in the lower bay area, with the notable exceptions of southern flounder and black drum. The fact that most flounder caught in the lower bay zone were taken late in the year as they migrated toward the passes and into Gulf waters may partially explain this phenomena. The catch of larger black drum in the lower bay zone is probably due to adult fish entering the bay system from deeper channels and nearshore waters.

In terms of number of individuals captured, white and brown shrimp were the most abundant species throughout the entire study. Among bycatch species, gulf menhaden (the most important commercial species), Atlantic croaker and spot were the most abundant. In biomass, cutlassfish, white shrimp, Atlantic croaker, gulf menhaden, brown shrimp and sand seatrout were among the highest ranked of all species captured. Overall, nine different species accounted for 80% of the bycatch (by number) and 79% of biomass (Table 14). These species include gulf menhaden, Atlantic croaker, spot, cutlassfish, sand seatrout, bay anchovy, Atlantic brief squid, hardhead catfish and blue crab .



Large, uncommon or otherwise noteworthy species which were not represented in the subsamples are listed in Table 15; it also includes information related to some common forms of large debris items, primarily crab traps and logs. The large species included: stingrays, sharks, flounder, cutlassfish, alligator gar, and crevalle jack. Noteworthy items included the catch of 3 cormorants (*Phalacrocorax* spp.) in East Bay. We were unable to distinguish whether the cormorants were sick, injured or died prior to being captured in the trawl. They were, however, captured on the same day in close proximity (2 different trawls, same vessel). Additionally, a spotfin butterflyfish was captured near the Galveston causeway. The catch of this species is unusual because it is primarily associated with submerged structure (reefs or rigs) in offshore marine waters. A tripletail was captured in the upper bay area; this species is commonly associated with floating rafts of *Sargassum* seaweed and other flotsam. The presence of these and other marine species (such as Spanish mackerel) within the estuary may provide some indication of tidal inputs from the Gulf of Mexico.

Monthly and overall ratios of shrimp to fish are provided in Table 16. Overall, the number of fish captured was almost 50% less than shrimp landings (0.53 to 1). In terms of biomass however, weight of fish captured was more than twice the landings of shrimp (2.64 kg to 1 kg shrimp). Invertebrate catches were much less than shrimp landings based on numbers (0.09:1) and biomass (0.39:1). Jellyfish, blue crabs (*Callinectes sapidus*, *C. similis*), roughback shrimp, mollusks (oysters, clams, etc.), mantis shrimp, and grass shrimp (*Palaemonetes* spp.) made up the bulk of invertebrates. The fish:shrimp and invertebrate:shrimp ratios varied monthly but provide a good indication of shrimp catch. The ratio of fish to shrimp was high during March and April (number and biomass) but values decreased dramatically in May as shrimp were found in greater numbers in the bay system; numbers increase during September-November. The lowest ratios of number of fish present in trawls to the number of shrimp landed occurred during September and November (0.23:1 and 0.25:1, respectively). Minimum ratios based on biomass were observed for the same months; lowest observed levels are 1.04 kg fish caught per shrimp landed during September and 1.55 fish caught per shrimp landed during November. The low ratios for biomass reflect white shrimp landings during the fall shrimping season. Variability in ratios may also be due to changes in the life histories of juvenile estuarine-dependent finfish; a decrease in the fish:shrimp ratio from one month to the next may result from emigration of individual finfish species out of the Galveston Bay system. Additionally, migration of shrimp to Gulf waters during May-July (brown shrimp) and November-December (white shrimp) may also affect ratios.

The bay-wide ratios were compared with total shrimp landings to estimate total catch of finfish and invertebrates during the 1992 shrimping season (Table 17). Based on the ratios and total shrimp landings, the estimates for total bycatch captured throughout Galveston Bay (March-November period) are 3,701,393 kg of finfish and 546,797 kg of invertebrates (total = 4,248,190 kg).

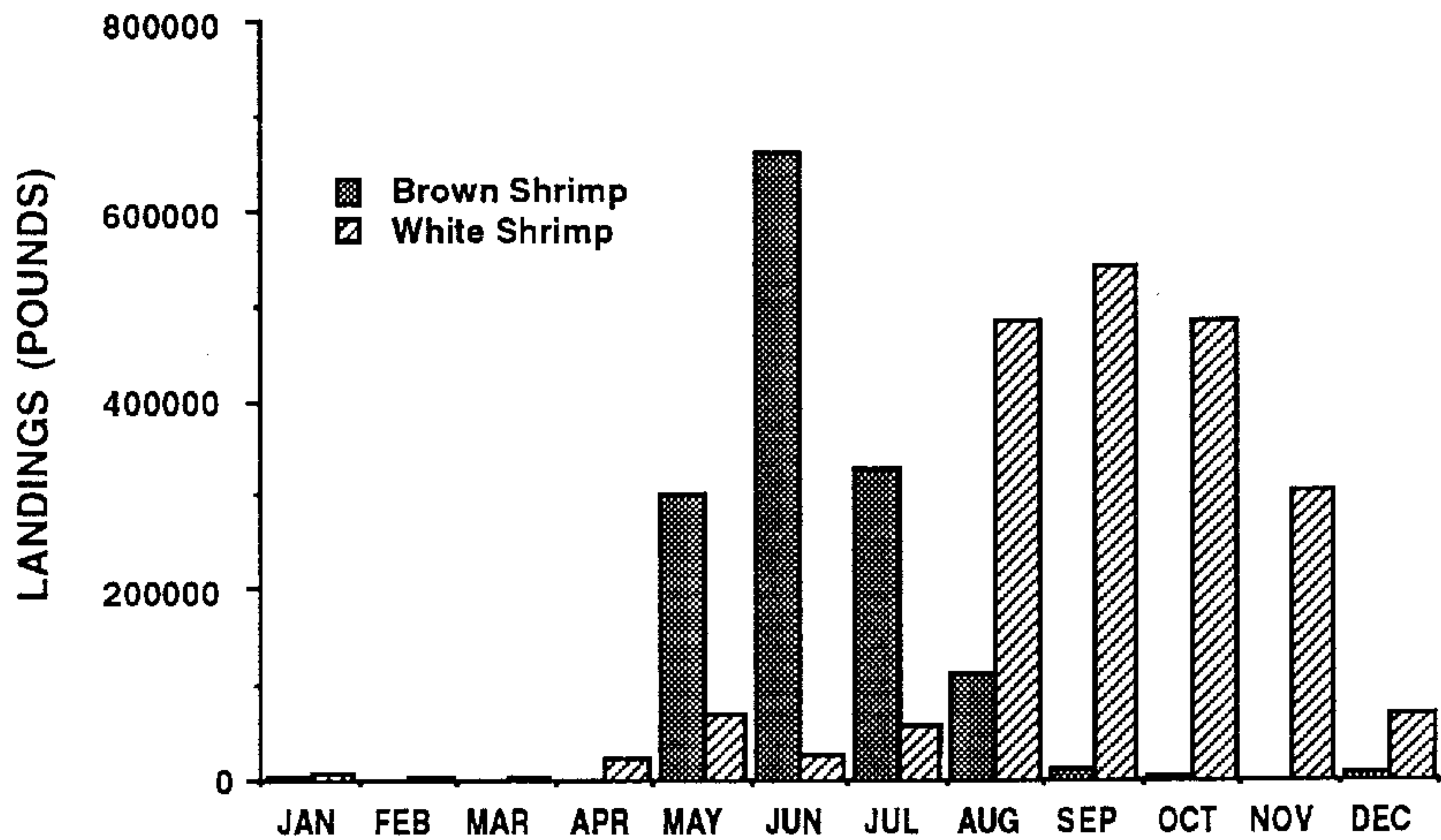


Figure 18. Average monthly brown and white shrimp catch from Galveston Bay during 1982-89 (data from NMFS landings files).

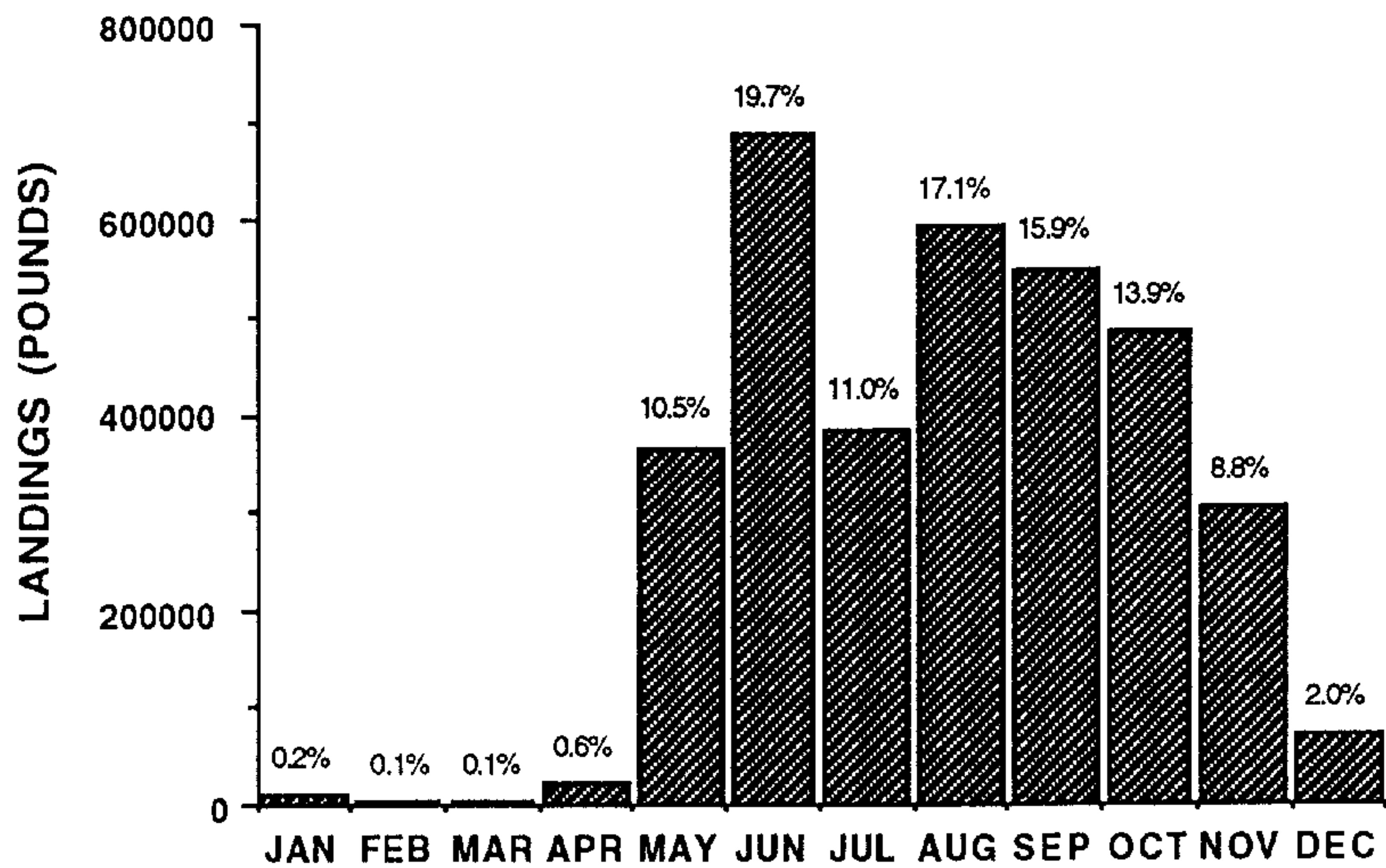


Figure 19. Average total shrimp catch (with monthly %'s) from Galveston Bay during 1982-89 (data from NMFS landings files).



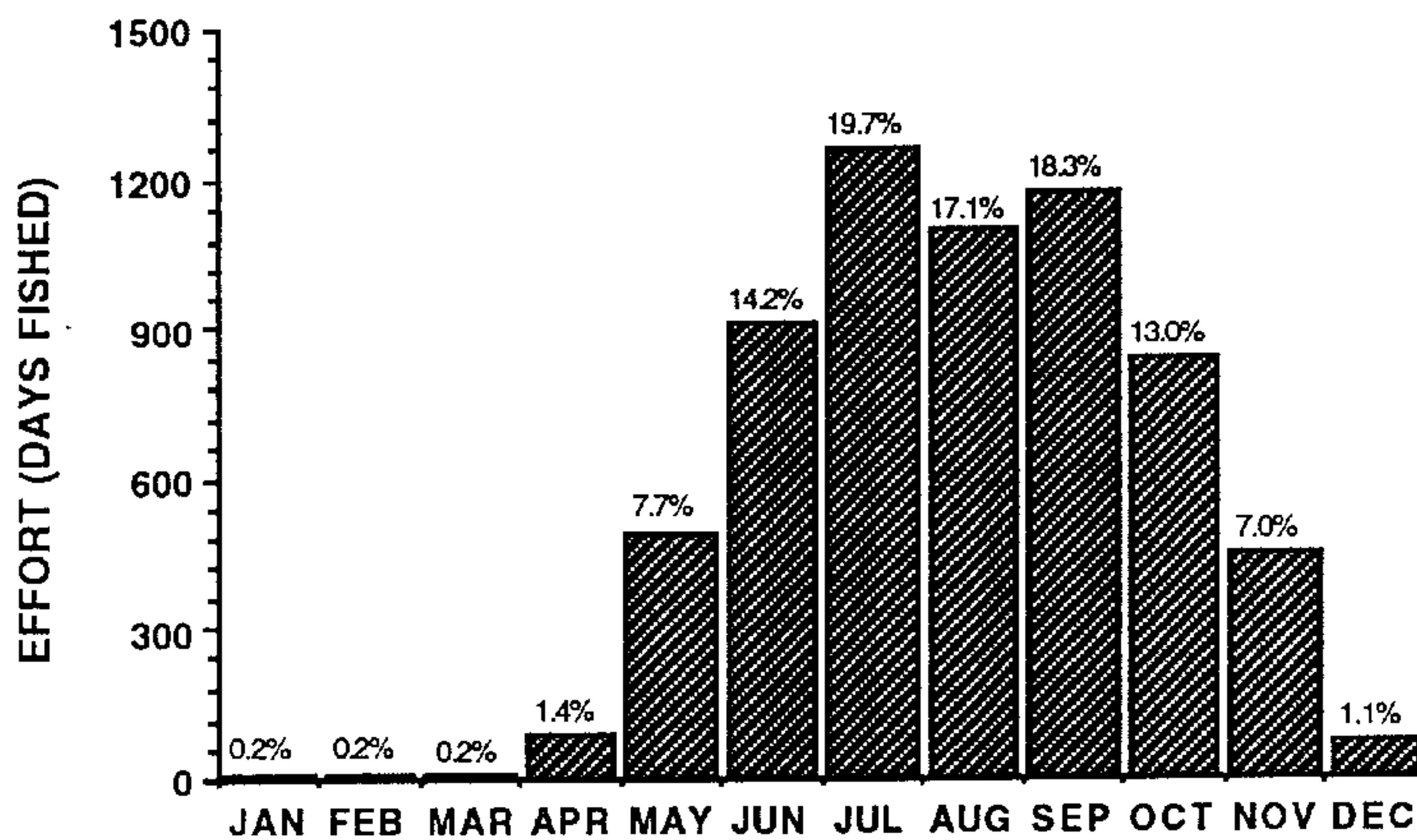


Figure 20. Average monthly shrimping effort (days fished) for Galveston Bay during 1982-89 (with monthly %'s).

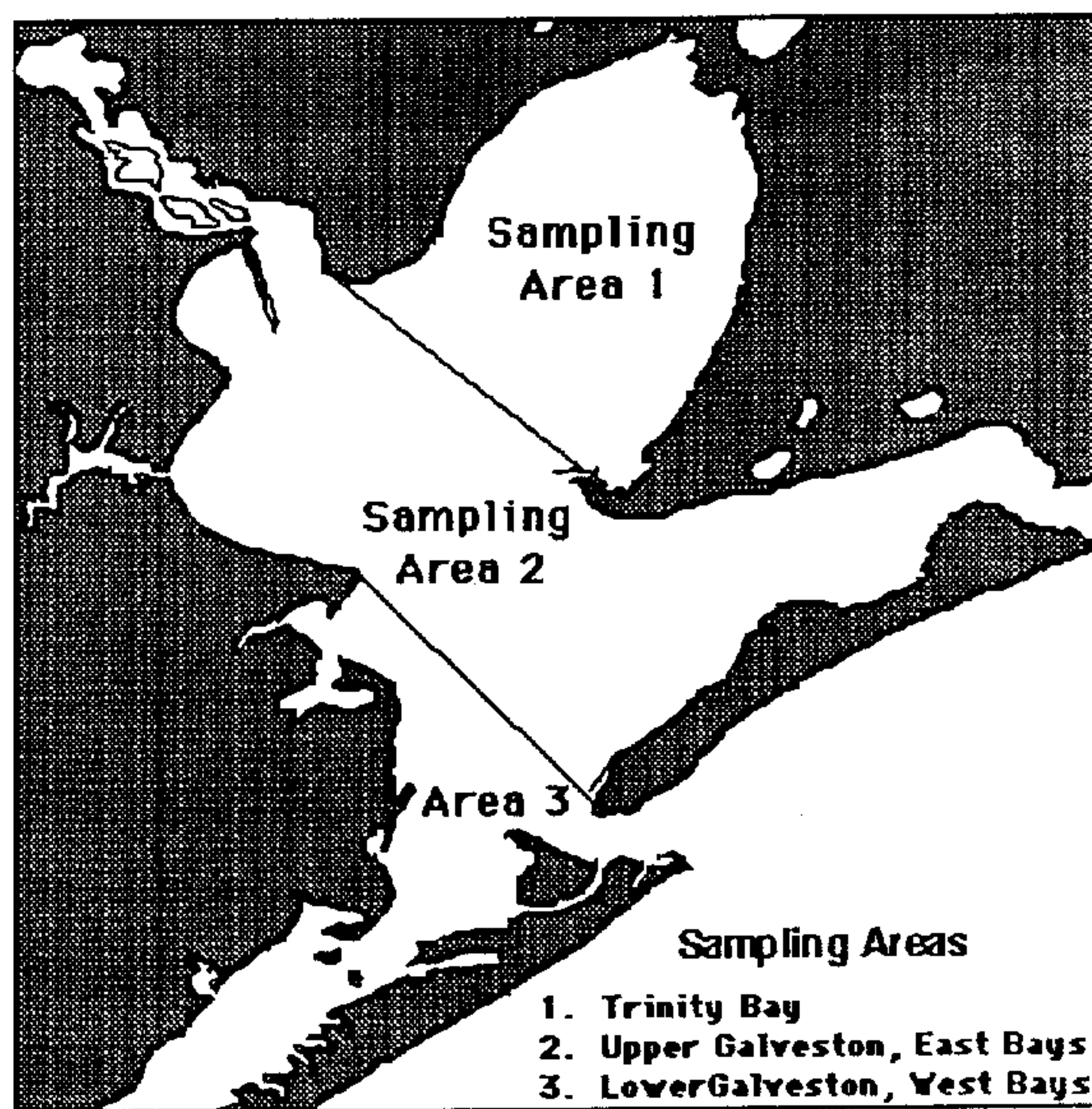


Figure 21. Map of Galveston Bay showing designated fishing zones for sample collection.

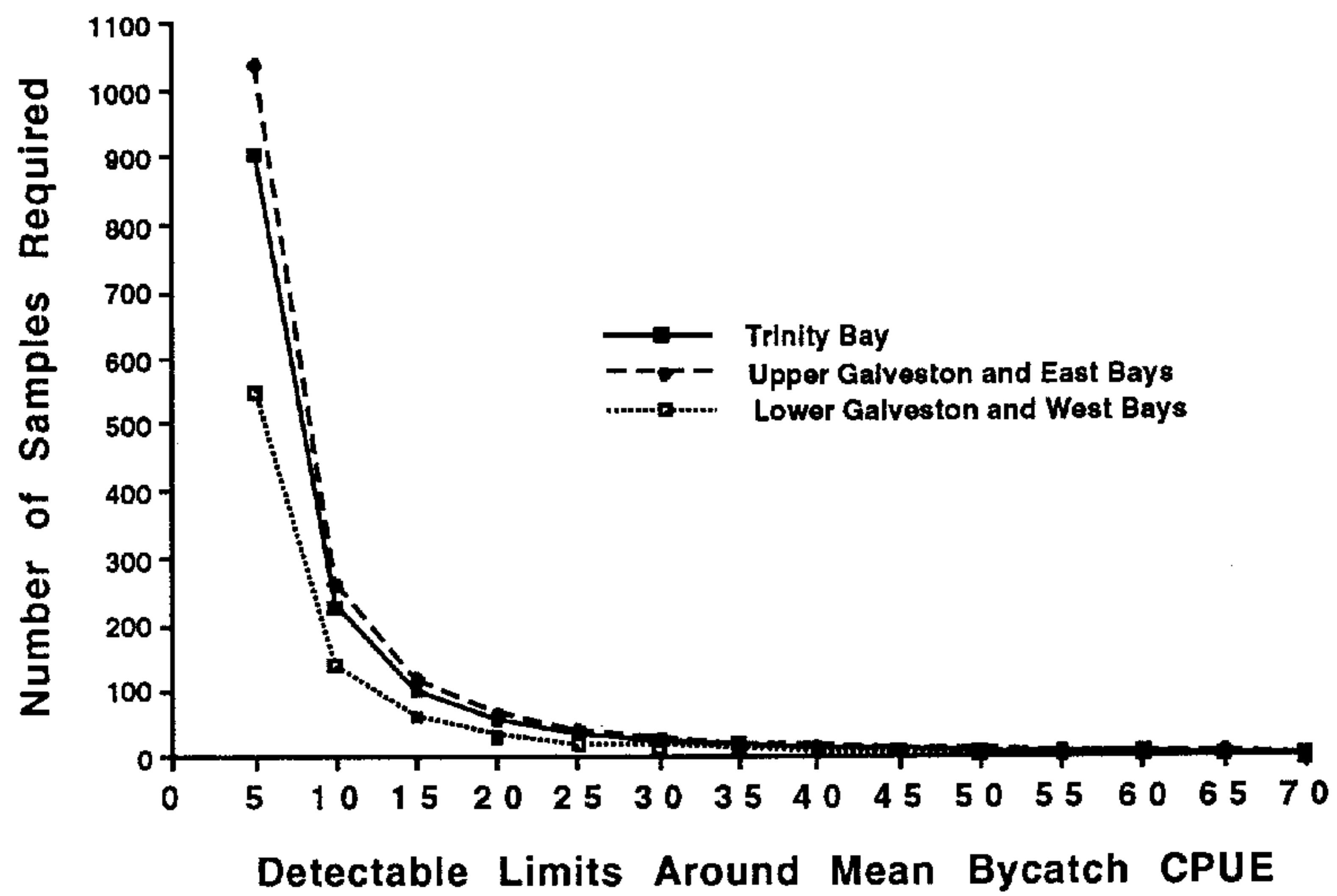
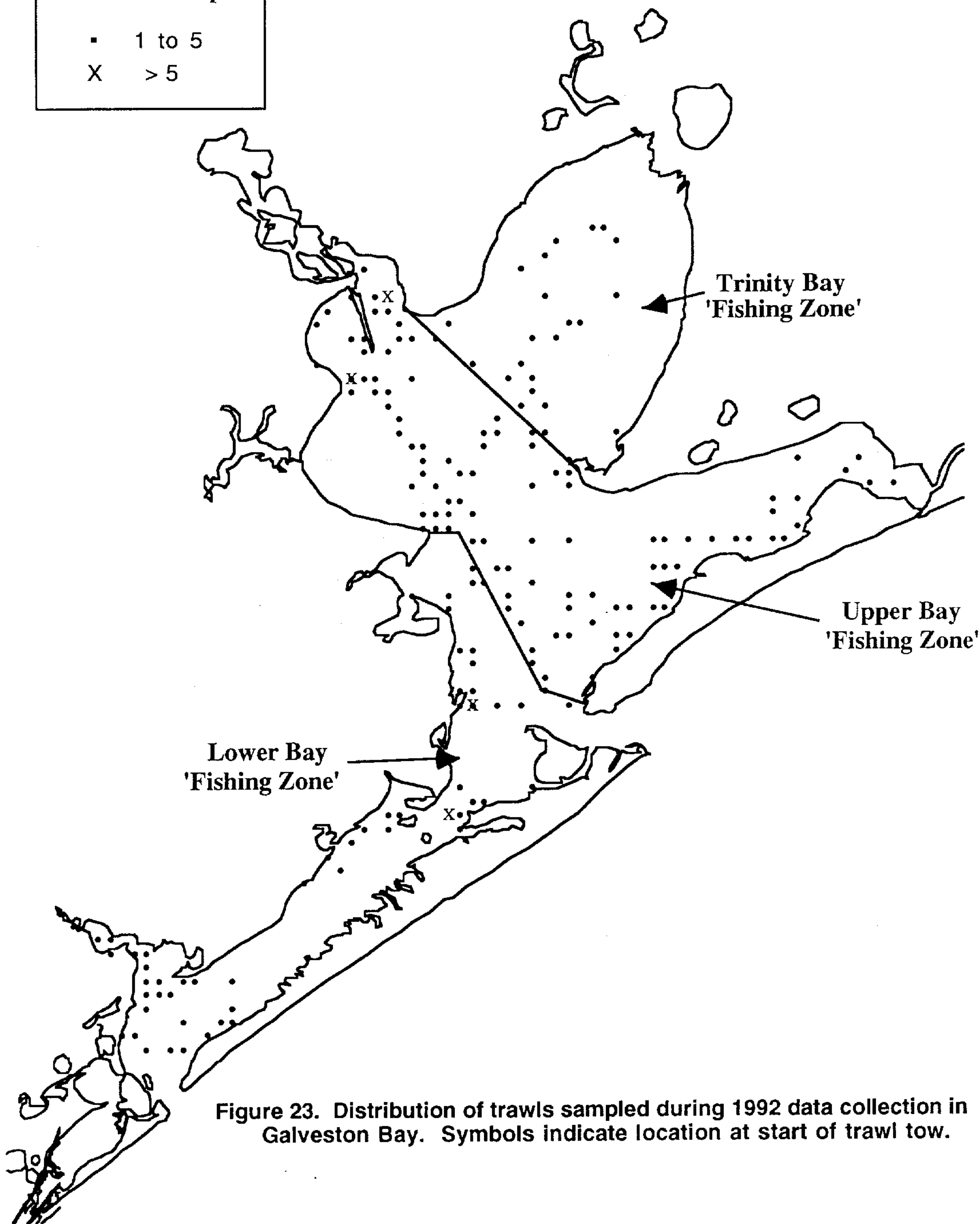


Figure 22. Sample size estimates for three fishing areas in Galveston Bay.

**# of Tows Sampled**

▪ 1 to 5

X > 5



**Figure 23. Distribution of trawls sampled during 1992 data collection in Galveston Bay. Symbols indicate location at start of trawl tow.**



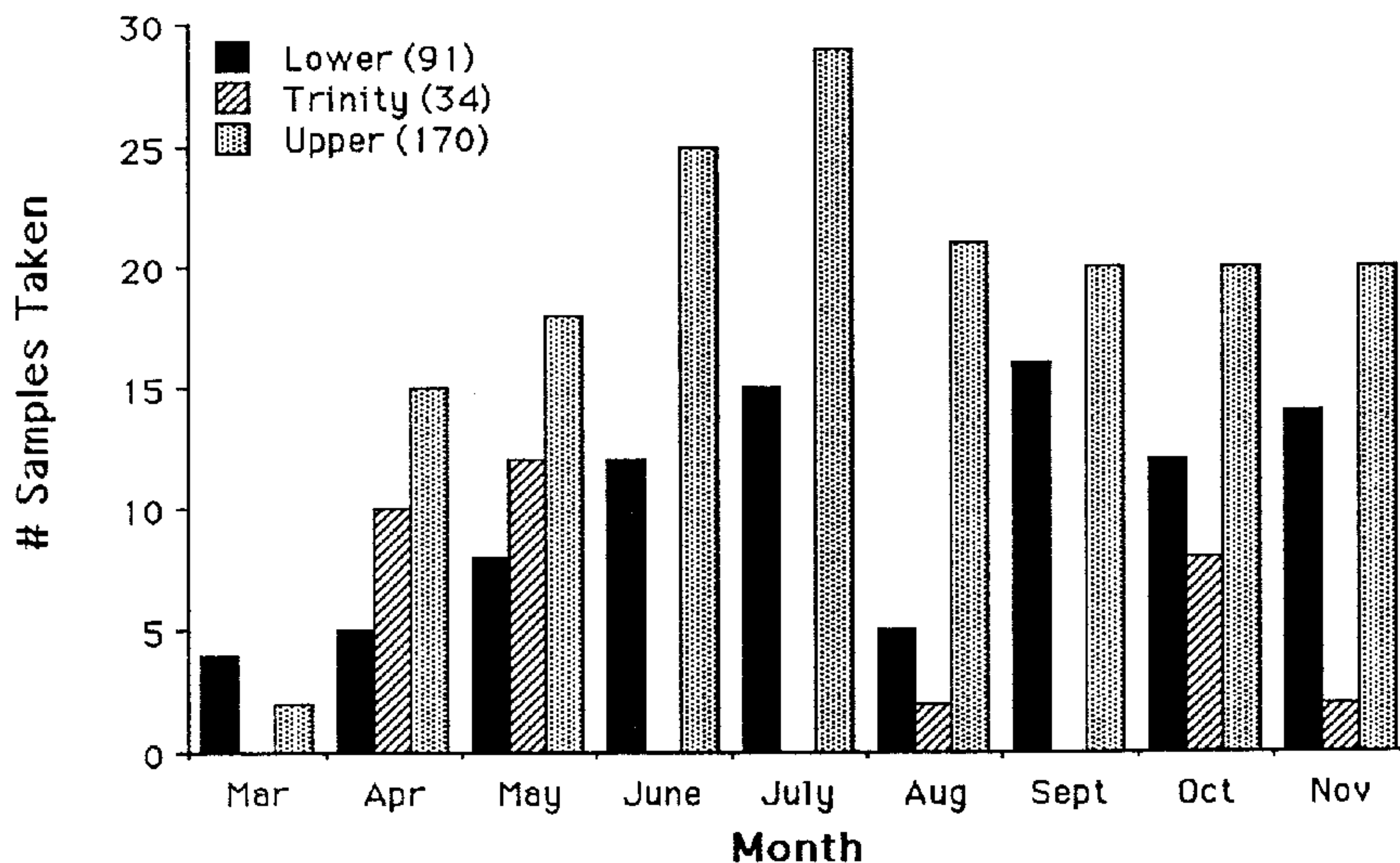


Figure 24. Monthly sampling intensity for the three "fishing zones" sampled in 1992. No samples were collected in Trinity Bay during March, June, July and September.

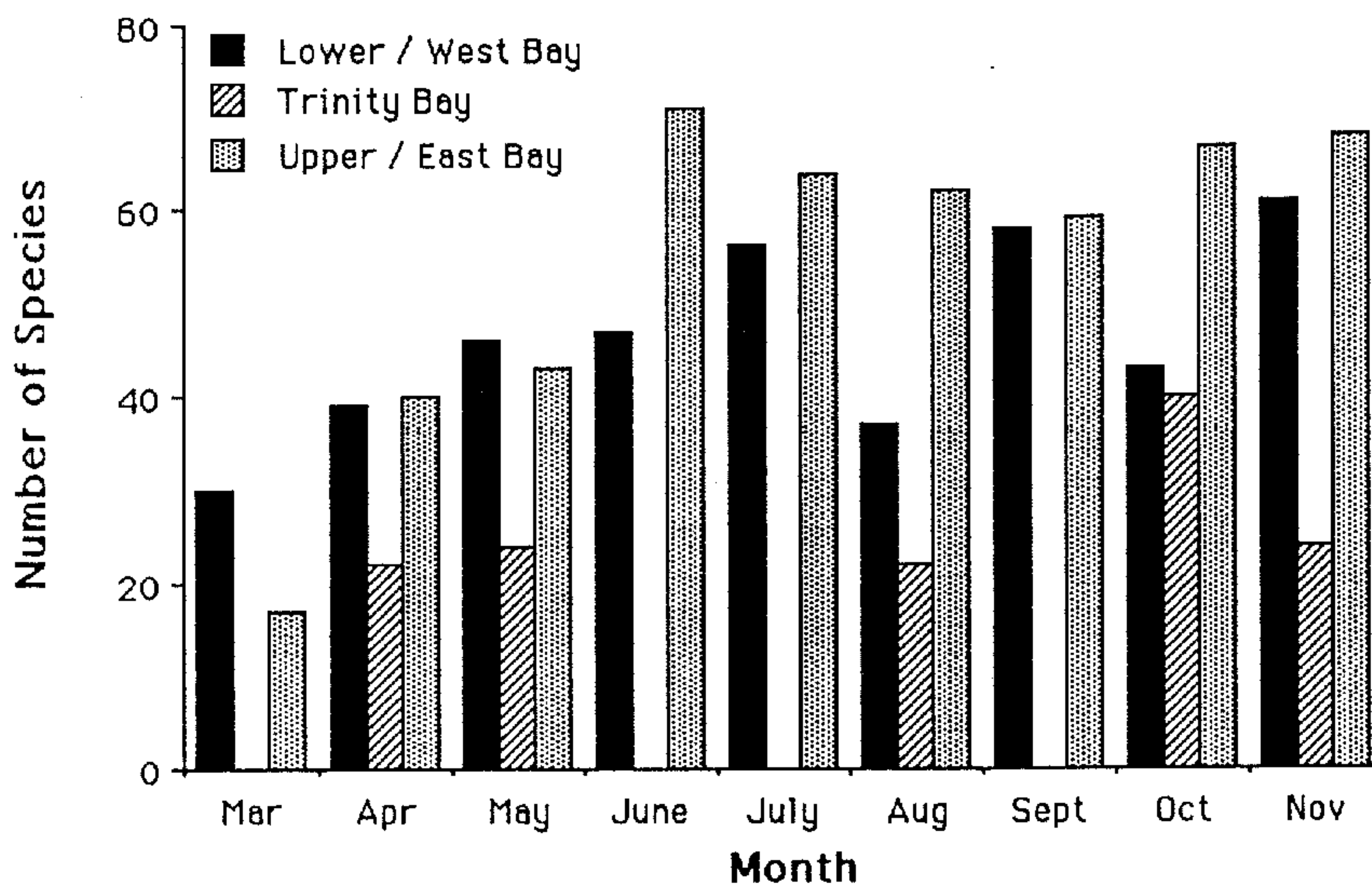


Figure 25. Number of species collected (finfish and invertebrates) in the three fishing zones during new sampling efforts.

Number of Individuals

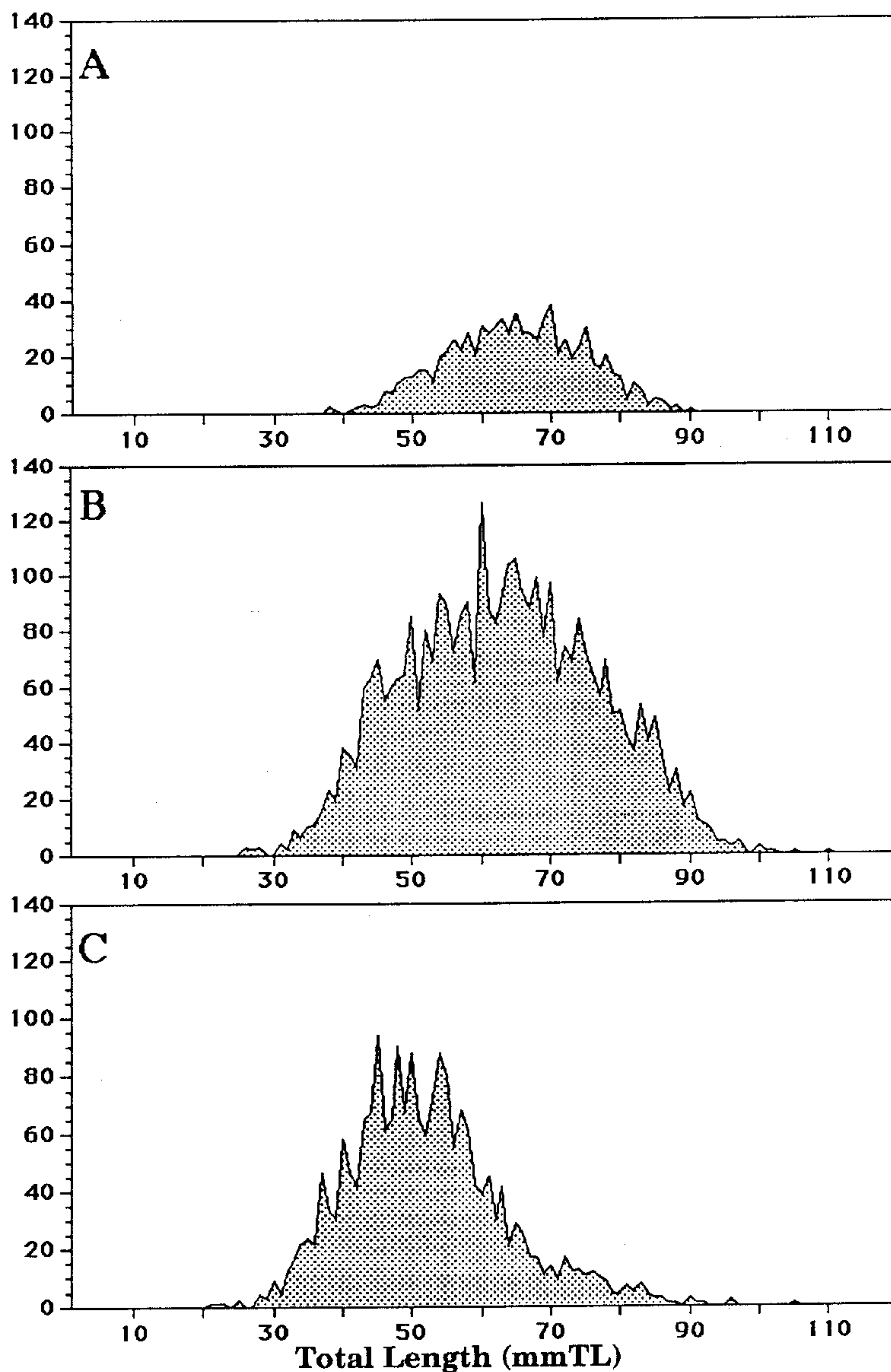


Figure 26. Size distribution (tail length) of white shrimp (*Penaeus setiferus*) in shrimp trawls sampled in **A**) Trinity Bay, **B**) Upper and East Galveston bays and **C**) Lower and West Galveston bays.

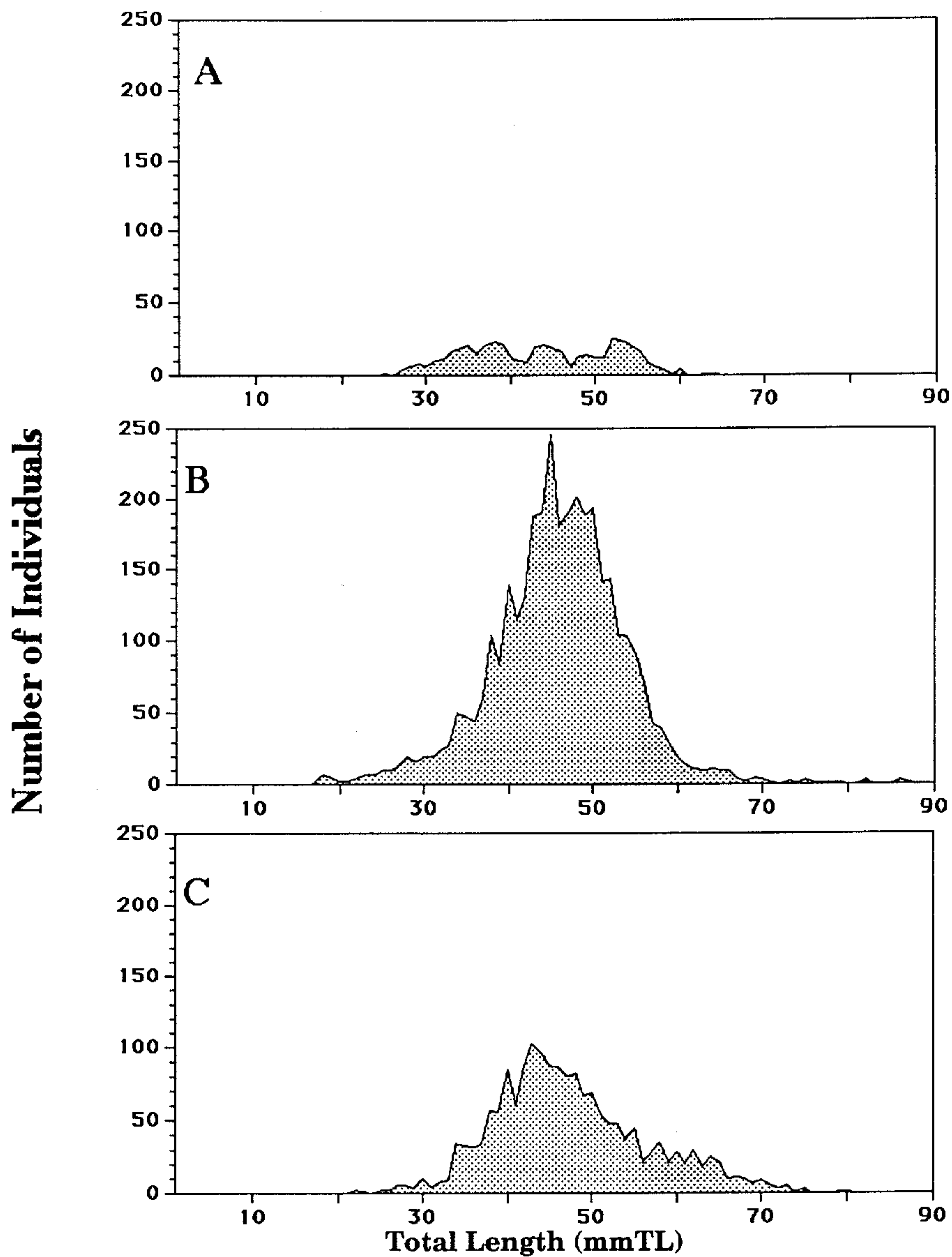


Figure 27. Size distribution (tail length) of brown shrimp (*Penaeus aztecus*) in shrimp trawls sampled in **A**) Trinity Bay, **B**) Upper and East Galveston bays and **C**) Lower and West Galveston bays.



Number of Individuals

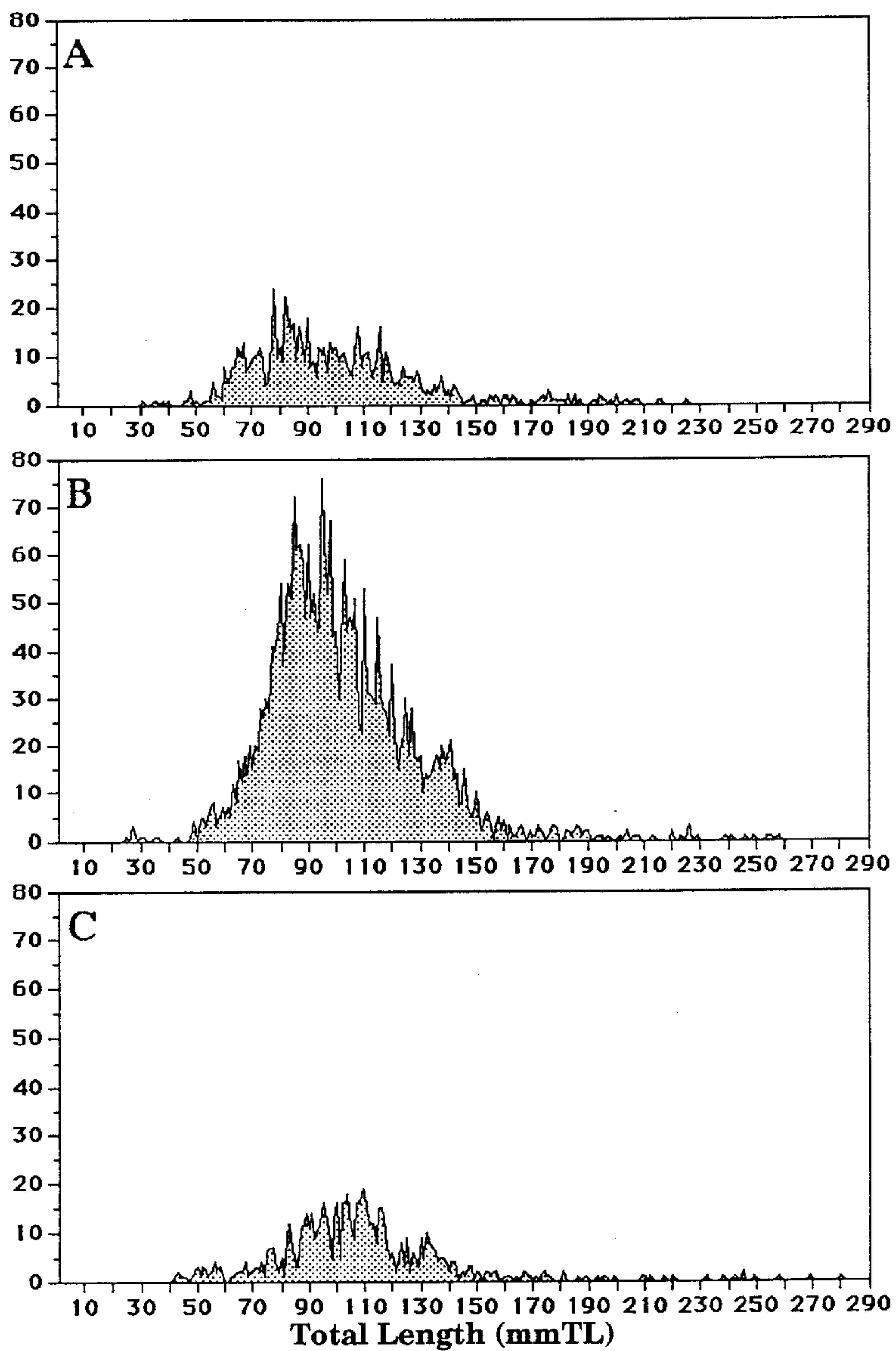


Figure 28. Size distribution of gulf menhaden (*Brevoortia patronus*) in shrimp trawls sampled in A) Trinity Bay, B) Upper and East Galveston bays and C) Lower and West Galveston bays.

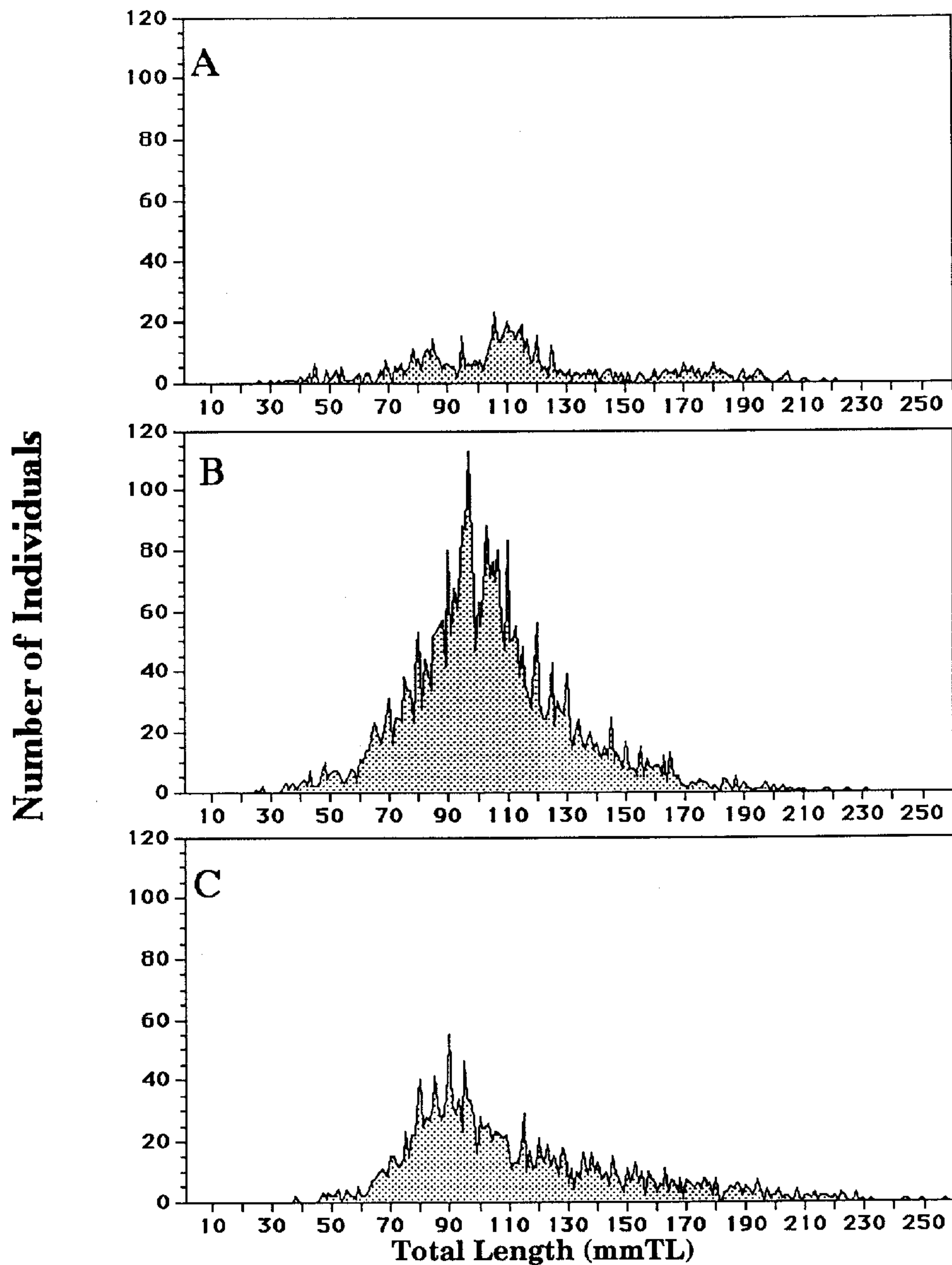


Figure 29. Size distribution of Atlantic croaker (*Micropogonias undulatus*) in shrimp trawls sampled in A) Trinity Bay, B) Upper and East Galveston bays and C) Lower and West Galveston bays.

Number of Individuals

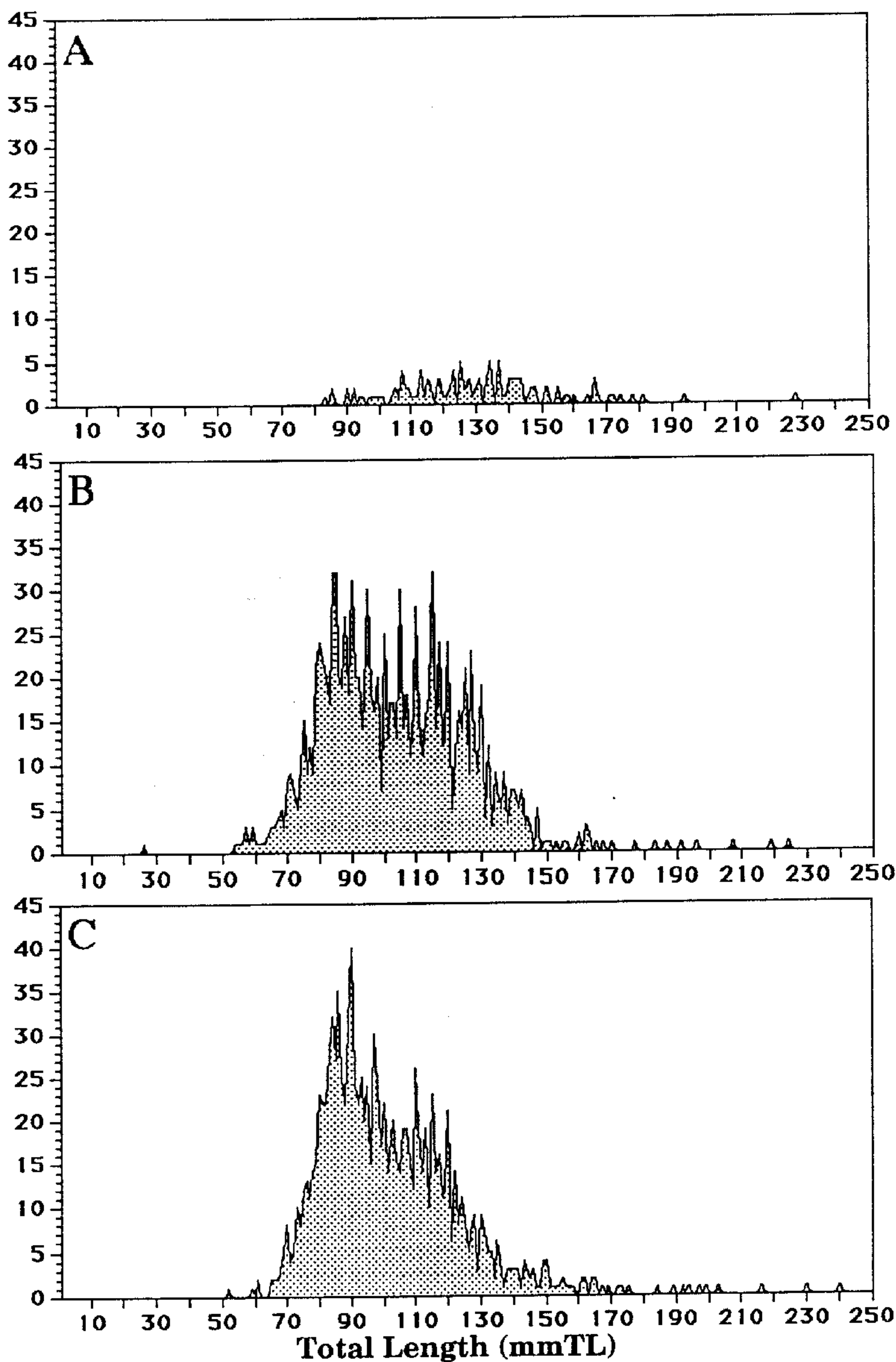


Figure 30. Size distribution of spot (*Leiostomus xanthurus*) in shrimp trawls sampled in A) Trinity Bay, B) Upper and East Galveston bays and C) Lower and West Galveston bays.



# Number of Individuals

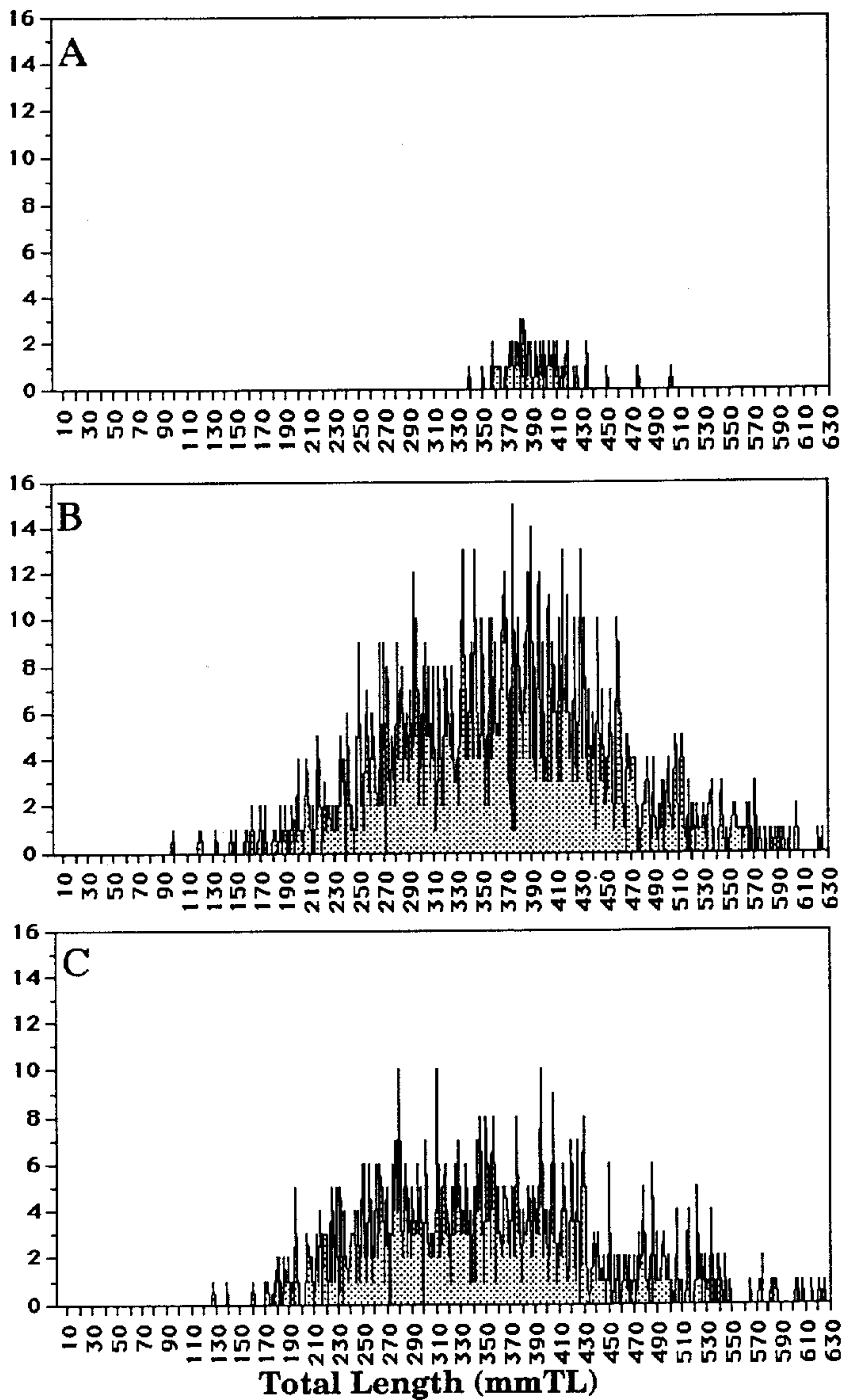


Figure 31. Size distribution of cutlassfish (*Trichiurus lepturus*) in shrimp trawls sampled in A) Trinity Bay, B) Upper and East Galveston bays and C) Lower and West Galveston bays.

Number of Individuals

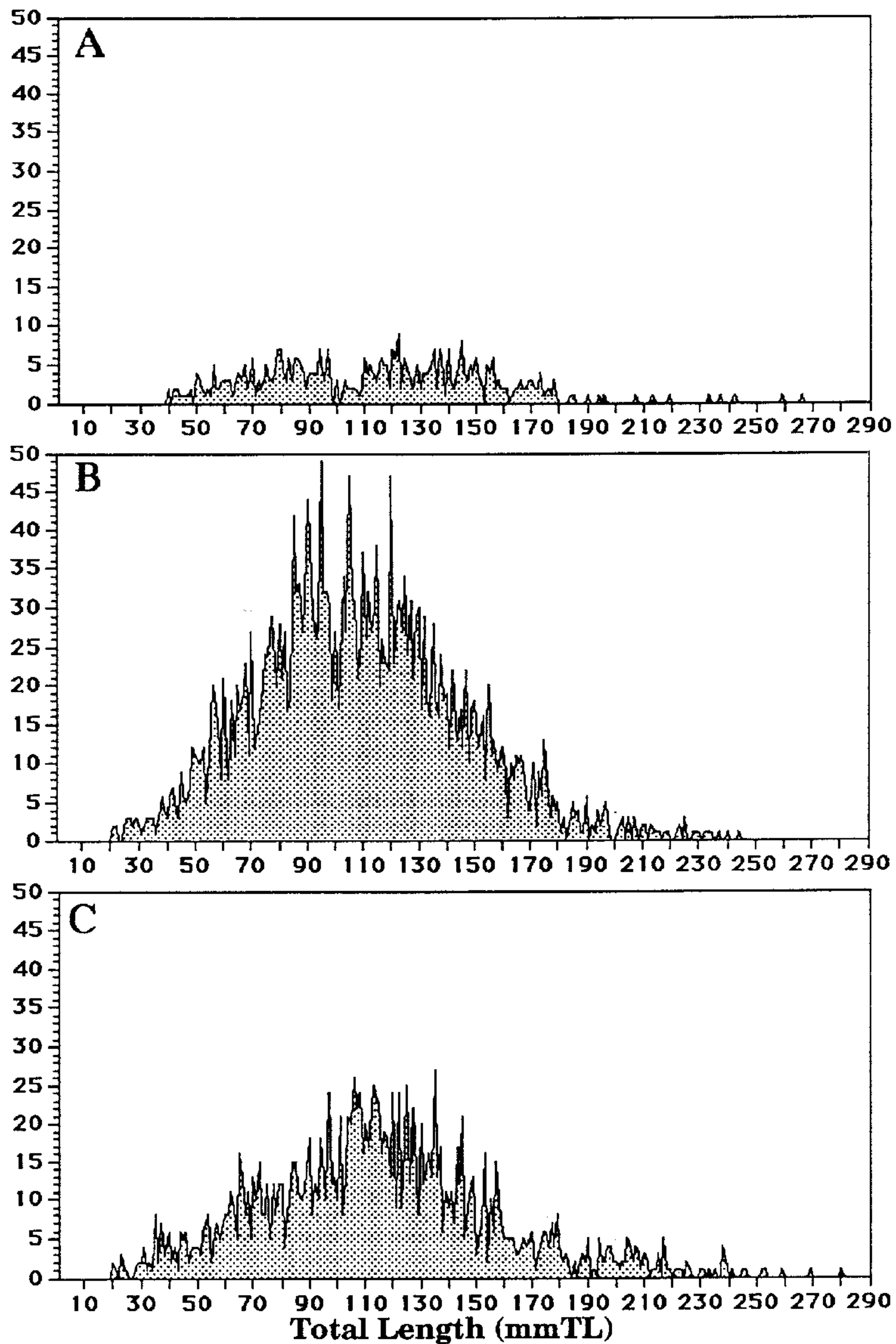


Figure 32. Size distribution of sand seatrout (*Cynoscion arenarius*) in shrimp trawls sampled in A) Trinity Bay, B) Upper and East Galveston bays and C) Lower and West Galveston bays.

# Number of Individuals

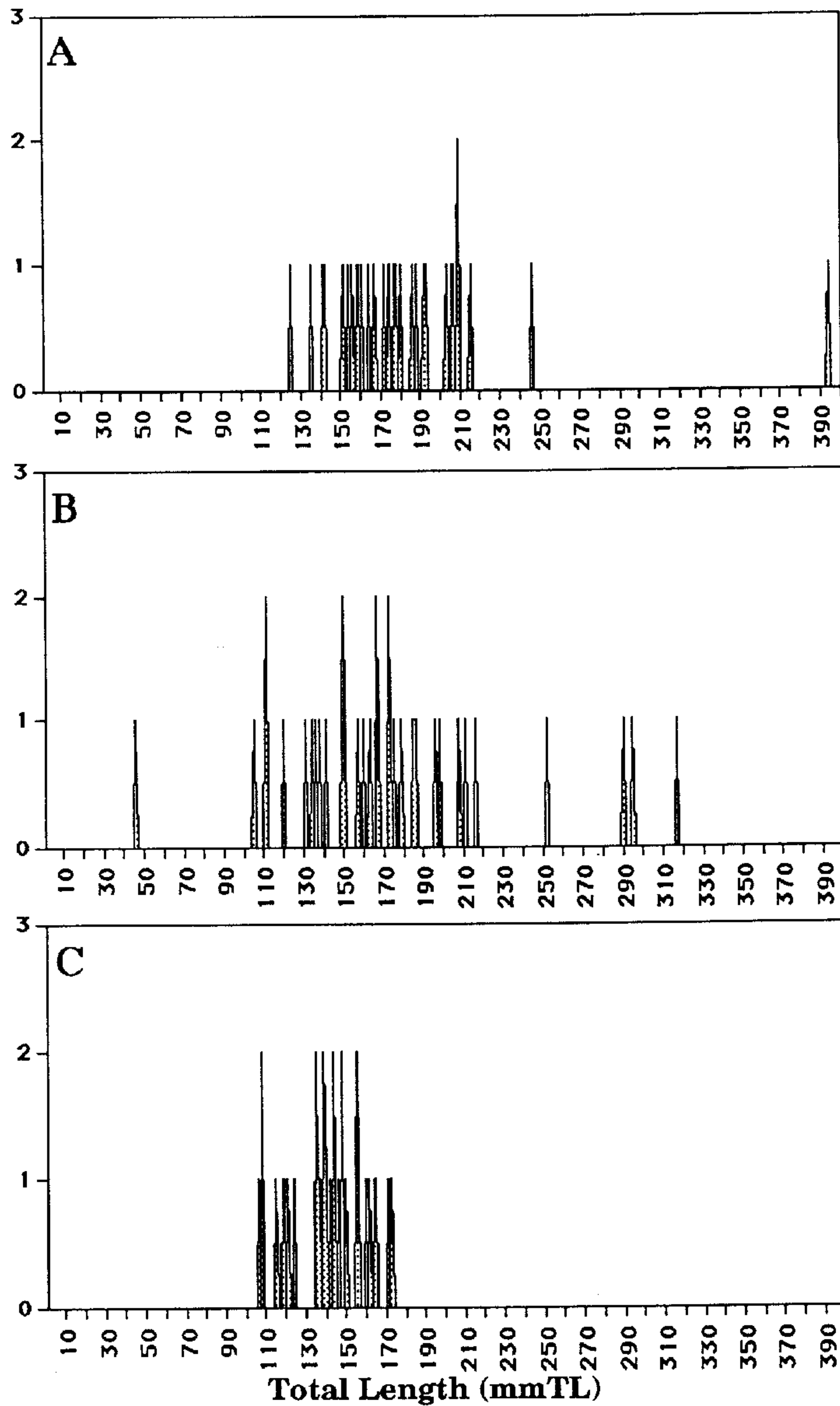


Figure 33. Size distribution of spotted seatrout (*Cynoscion nebulosus*) in shrimp trawls sampled in **A**) Trinity Bay, **B**) Upper and East Galveston bays and **C**) Lower and West Galveston bays.



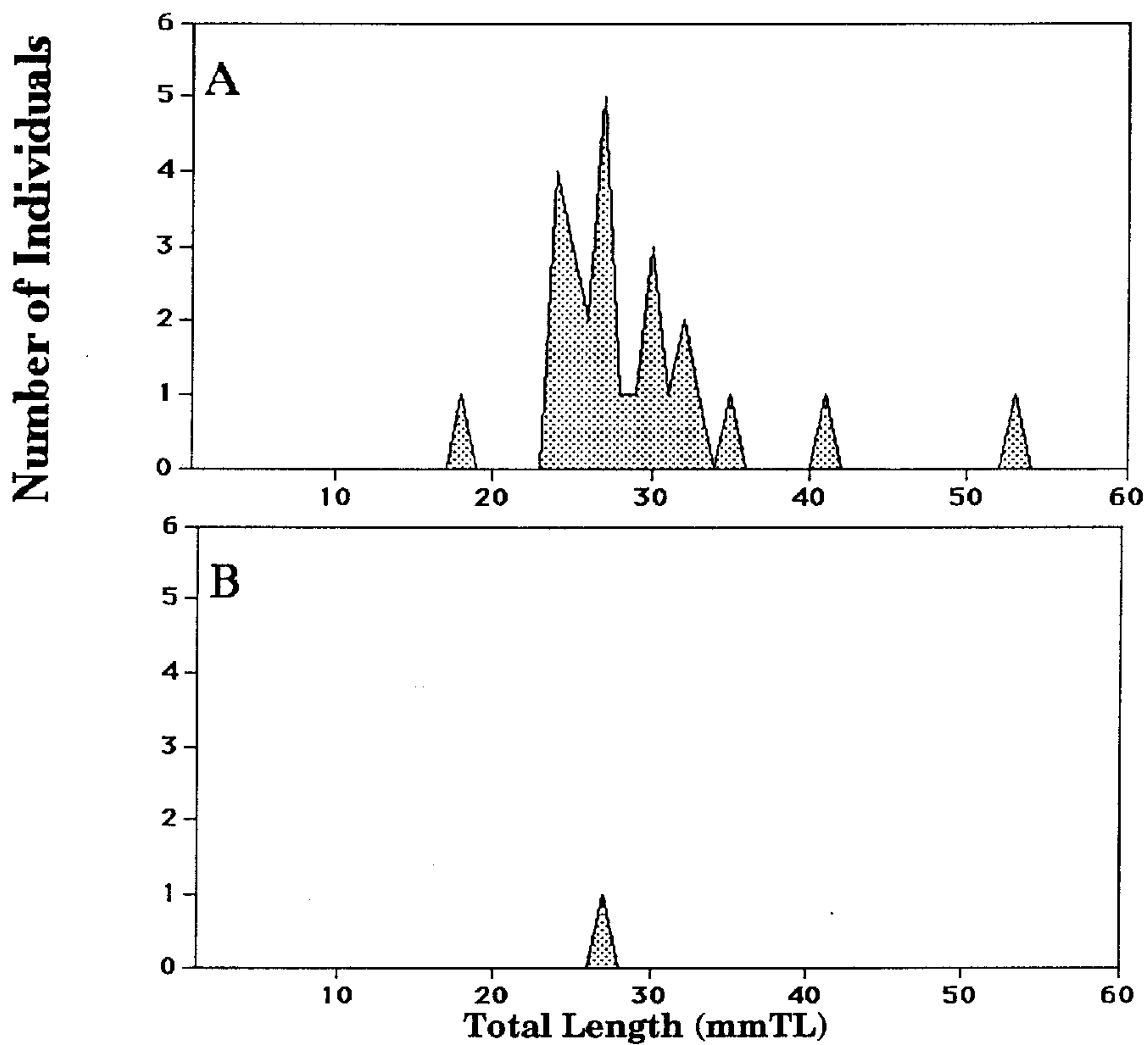


Figure 34. Size distribution of red drum (*Sciaenops ocellatus*) in shrimp trawls sampled in **A**) Upper and East Galveston bays and **B**) Lower and West Galveston bays.

# Number of Individuals

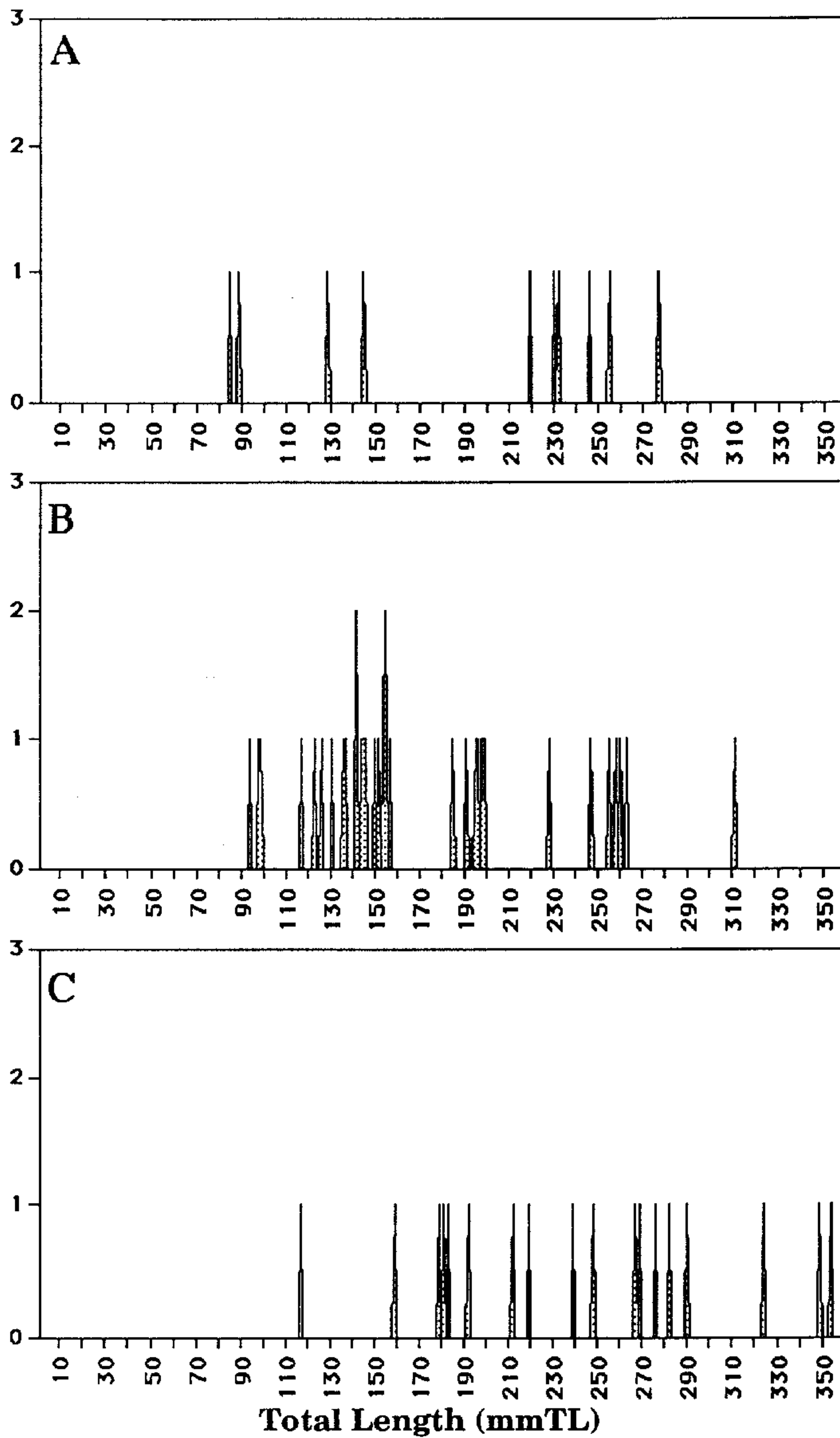


Figure 35. Size distribution of southern flounder (*Paralichthys lethostigma*) in shrimp trawls sampled in **A**) Trinity Bay, **B**) Upper and East Galveston bays and **C**) Lower and West Galveston bays.

# Number of Individuals

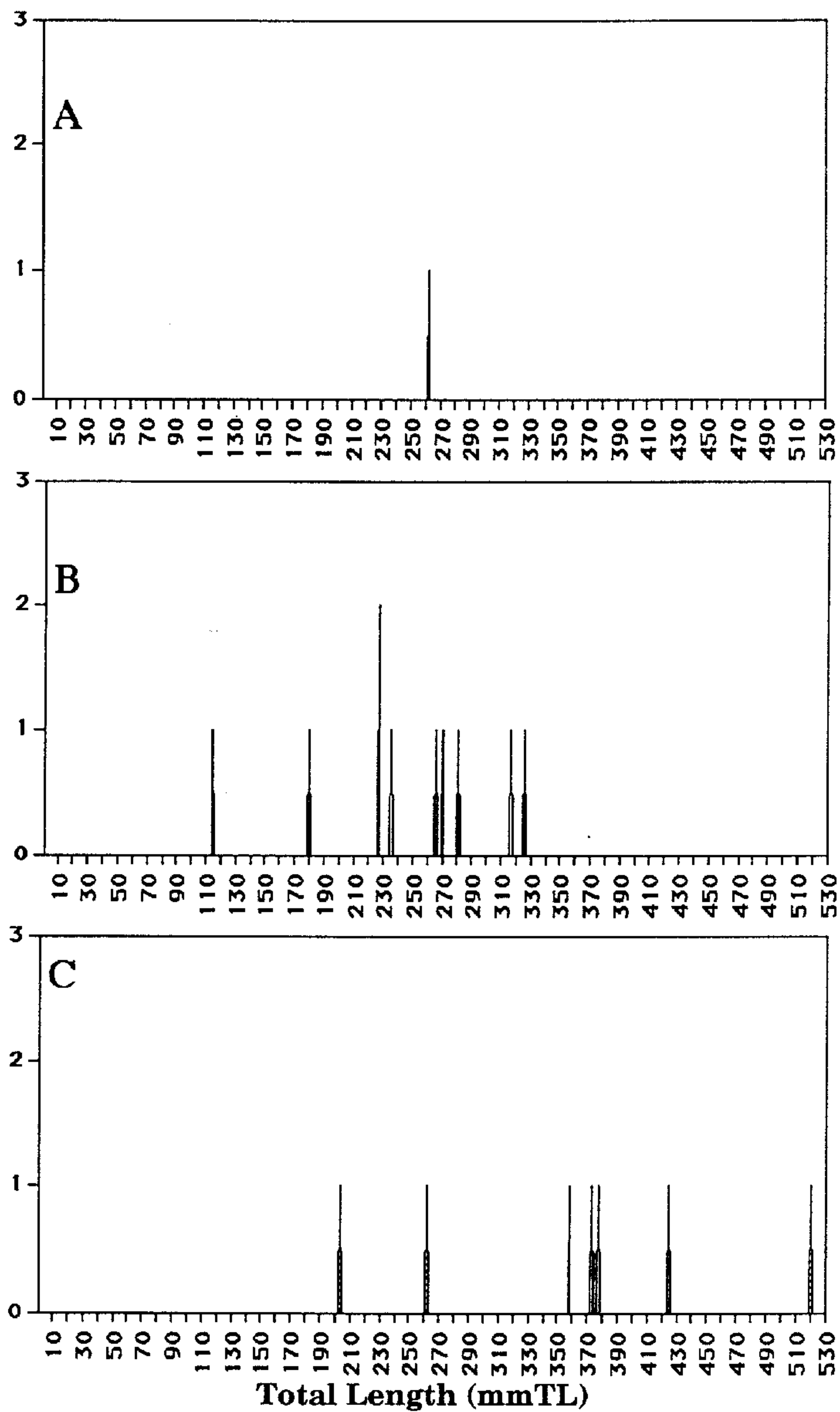


Figure 36. Size distribution of black drum (*Pogonias cromis*) in shrimp trawls sampled in **A**) Trinity Bay, **B**) Upper and East Galveston bays and **C**) Lower and West Galveston bays.



**Table 9. Minimum sampling intensity projected for Galveston Bay bycatch study. Thirty-six samples per month are projected from May - November (252 samples, 56 sampling days); twenty-eight samples projected for the December - April period (randomly distributed in time). A minimum of 280 samples are thus required (projected) for 1992 sampling efforts.**

Bay Area	May - November Period		December - April Period		Total Samples For Area
	Samples / Month	Days Required	Samples / Period	Days Required	
Trinity Bay	13	3	10	2	101
Upper Galveston, East Bays	15	3	12	3	117
Lower Galveston, West Bays	8	2	6	2	62
<b>Totals --&gt;</b>	<b>36 (per month)</b>	<b>8 (per month)</b>	<b>28</b>	<b>7</b>	<b>280</b>

**Table 10. Monthly distribution of samples taken in Galveston Bay 'fishing zones' during 1992.**

Month	Trinity Bay	Upper Galveston and East Bays	Lower Galveston and West Bays	Monthly Total
March	-	1	4	5
April	10	15	5	30
May	12	16	8	36
June	-	25	12	37
July	-	26	15	41
August	2	21	5	28
September	-	20	16	36
October	8	20	12	40
November	2	20	14	36
<b>Area Total -&gt;</b>	<b>34</b>	<b>164</b>	<b>91</b>	<b>289</b>

Table 11. Total CPUE (by number and weight) and temporal distribution of individual species captured in Galveston Bay shrimp trawls during 1992. Plus (+) symbols indicate presence in Galveston Bay during specified month. The total number of tows each species occurs in (out of 291) are also provided. Common names follow American Fisheries Society standards (Turgeon et al. 1988, Williams et al. 1988, Robins et al. 1991). Scientific names provided in Appendix 1; names in parentheses are for species not listed in AFS special publications for nomenclature.

Common Name	# Tows	#/hr/net	kg/hr/net	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV
American Oyster	66	0.00	115.319		+	+	+	+	+	+	+	+
Angelwing	15	0.00	0.778			+	+		+			
Atlantic Brief Squid	190	45,249.20	420.438		+	+	+	+	+	+	+	+
Atlantic Bumper	60	2,133.17	14.168				+	+	+	+	+	+
Atlantic Croaker	290	294,627.79	2,733.242	+	+	+	+	+	+	+	+	+
Atlantic Midshipman	79	2,593.92	59.541		+	+	+	+	+	+	+	+
Atlantic Mud Crab	5	30.73	0.062		+		+	+				
Atlantic Rangia	18	8.06	281.374		+	+			+	+		+
Atlantic Sharpnose Shark	4	63.11	9.394				+					
Atlantic Spadefish	121	3,923.65	75.929	+	+	+	+	+	+	+	+	+
Atlantic Stingray	32	313.16	127.890				+	+	+	+	+	+
Atlantic Thread Herring	1	1.42	0.164						+			
Atlantic Threadfin	11	204.49	4.714			+	+	+				
Banded Drum	32	1,444.82	25.595		+	+	+	+			+	+
Bay Anchovy	260	56,812.08	68.772	+	+	+	+	+	+	+	+	+
Bay Whiff	189	24,452.65	135.052	+	+	+	+	+	+	+	+	+
Bent Mussel ( <i>Brachidontes recurvus</i> )	1	0.00	0.029					+				
Bighead Sea Robin	116	4,617.82	54.088	+	+	+	+	+	+	+	+	+
Black Drum	15	121.14	32.166		+	+	+		+		+	+
Blackcheek Tonguefish	29	472.66	3.217		+	+	+	+	+	+	+	+
Blacktip Shark	1	5.01	4.271				+					
Blackwing Sea Robin	25	791.44	3.350	+	+	+	+	+		+	+	+
Blood Ark	3	0.00	0.399				+					
Blotched Swimming Crab	2	7.12	0.077								+	+
Blue Catfish	27	8,032.40	299.036		+	+	+					
Blue Crab	244	25,411.35	30.170	+	+	+	+	+	+	+	+	+
Bluefish	4	19.96	1.149	+		+						+
Bluntnose Jack	67	785.32	5.430						+	+	+	+
Brackish Grass Shrimp	4	144.56	0.023		+		+					
Brown Shrimp	270	946,283.54	1,893.921	+	+	+	+	+	+	+	+	+
Butterfish ( <i>Peprilus spp.</i> )	1	0.00	0.016									+
Calico Box Crab	1	14.02	0.168				+					

Table 11 (continued):

Common Name	# Tows	#/hr/net	kg/hr/net	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV
Clown Goby	1	24.70	0.007		+							
Common Barnacle ( <i>Balanus spp.</i> )	1	0.00	0.002				+					
Cownose Ray	1	2.78	0.967				+					
Crevalle Jack	19	226.65	5.559					+	+	+	+	+
Cutlassfish	199	81,556.99	3,177.100	+	+	+	+	+	+	+	+	+
Daggerblade Grass Shrimp	5	260.29	0.023	+	+		+	+	+			
Darter Goby	2	17.50	0.002									+
Debris	206	18.01	164.841	+	+	+	+	+	+	+	+	+
Dimpled Hermit Crab	1	0.00	0.108									+
Dwarf Herring	1	13.81	0.004				+					
Flagfin Mojarra	8	100.02	0.714							+	+	
Flatback Mud Crab	1	2.36	0.000					+				
Florida Rocksnail	1	3.25	0.005		+							
Florida Stone Crab	4	48.65	4.504					+		+	+	
Fringed Flounder	143	8,637.72	52.250	+	+	+	+	+	+	+	+	+
Gafftopsail Catfish	105	10,272.28	297.556	+	+	+	+	+	+	+	+	+
Gizzard Shad	52	2,885.25	53.212	+	+	+	+	+	+	+	+	+
Grass Shrimp	10	780.80	0.108		+		+	+	+		+	
Gray Snapper	2	12.50	0.202							+	+	
Green Porcelain Crab	1	15.27	0.008									+
Guaguanche	13	79.50	0.422					+		+	+	
Gulf Butterfish	43	1,228.10	16.340	+	+	+	+	+			+	+
Gulf Menhaden	260	308,477.10	2,679.139	+	+	+	+	+	+	+	+	+
Gulf Oyster Drill	1	0.00	0.054				+					
Gulf Toadfish	18	274.49	20.396		+	+	+	+		+	+	
Hardhead Catfish	234	36,904.46	556.660	+	+	+	+	+	+	+	+	+
Harris Mud Crab	1	14.11	0.001								+	
Harvestfish	154	6,659.03	105.322		+	+	+	+	+	+	+	+
Hermit Crab	2	0.00	0.118								+	
Highfin Goby	11	184.41	3.546		+		+	+	+			+
Hogchoker	60	1,585.61	15.418		+	+	+	+	+	+	+	+
Hooked Mussel	1	0.00	0.009					+				
Horse-Eye Jack	1	9.65	0.099						+			
Inshore Lizardfish	132	4,142.74	155.349	+		+	+	+	+	+	+	+
Iridescent Swimming Crab	21	430.93	1.658				+			+	+	+



Table 11 (continued):

Common Name	# Tows	#/hr/net	kg/hr/net	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV
Ladyfish	10	94.85	9.623					+	+	+		
Lane Snapper	1	3.54	0.202									+
Least Puffer	130	4,072.37	18.844	+	+	+	+	+	+	+	+	+
Leatherjack	1	5.12	0.038								+	
Lesser Blue Crab	100	7,044.73	882.635			+	+	+	+	+	+	+
Lesser Rock Shrimp	7	55.62	0.040		+						+	+
Lined Sole	18	523.36	1.811							+	+	+
Longnose Spider Crab	4	210.68	0.092			+		+	+			
Lookdown	47	704.01	4.848				+	+	+	+	+	+
Mantis Shrimp ( <i>Squilla empusa</i> )	84	9,363.68	67.160	+	+	+	+	+	+	+	+	+
Marsh Grass Shrimp	2	24.94	0.003			+	+					
Moon Snail ( <i>Polinices duplicatus</i> )	8	0.00	2.615					+		+		+
Moonfish	24	244.92	0.696					+	+	+	+	+
Mud Crab ( <i>Neopanopeus texanus</i> )	3	42.84	0.011					+			+	+
Ocellated Flounder	3	19.91	1.134	+			+					
Ohio Shrimp	36	1,891.76	4.089		+	+	+	+				
Parasitic Isopod	155	3,709.92	0.735		+	+	+	+	+	+	+	+
Penaeid Shrimp	1	3.05	0.005	+								
Peppermint Shrimp	1	46.13	0.005								+	
Perverse Whelk ( <i>Busycon perversum</i> )	2	0.00	0.059				+					+
Pigfish	15	485.42	47.516		+	+	+	+				+
Pinfish	65	2,585.00	81.802		+	+	+	+	+	+	+	+
Pink Shrimp	21	554.35	2.333	+	+	+					+	+
Pipefish	2	29.37	0.038				+					+
Planehead Filefish	4	21.48	0.131								+	+
Purplish Tagelus	1	0.00	0.027					+				
Red Drum	8	652.15	0.114					+				+
Rock Sea Bass	6	27.88	0.715				+				+	+
Rough Silverside	3	44.27	0.104							+	+	
Roughback Shrimp	103	29,959.20	25.180	+	+	+	+	+	+	+	+	+
Sand Seatrout	284	68,356.74	1,066.071	+	+	+	+	+	+	+	+	+
Sargassum Seaweed	17	0.00	3.088			+	+	+	+	+	+	
Scaled Sardine	22	620.21	2.241						+	+	+	+
Scalloped Hammerhead	1	29.56	11.511				+					
Seabob	37	1,798.46	3.524					+	+	+	+	+

Table 11 (continued):

Common Name	# Tows	#/hr/net	kg/hr/net	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV
Sergestid Shrimp ( <i>Acetes americanus</i> )	20	56,329.60	3.664			+	+	+	+	+	+	+
Sheephead	12	87.49	19.239		+	+		+		+	+	+
Shrimp Eel	8	124.20	10.232			+		+	+	+		+
Silver Jenny	10	125.00	0.890							+	+	+
Silver Perch	57	3,506.07	63.890	+	+	+	+	+	+	+	+	+
Silver Seatrout	12	614.30	22.076	+	+	+	+					
Skilletfish	1	6.10	0.093									+
Smoothhead Scorpionfish	2	14.53	0.284									+
Southern Flounder	40	347.20	48.166		+	+	+	+	+		+	+
Southern Hake	12	545.17	24.561	+	+	+						
Southern Kingfish	47	686.51	29.178	+	+	+	+	+	+	+	+	+
Southern Stargazer	4	29.31	0.083									+
Spanish Mackerel	62	875.02	28.326				+	+	+	+	+	
Spot	230	82,874.91	881.423	+	+	+	+	+	+	+	+	+
Spotfin Mojarra	9	85.17	0.809				+		+	+		+
Spotted Seatrout	32	814.37	31.973	+	+	+	+		+		+	+
Star Drum	78	4,675.23	25.198		+		+	+	+	+	+	+
Stout Tagelus	1	0.00	0.106						+			
Striped Anchovy	32	1,385.77	7.685				+	+	+	+	+	+
Striped Blenny	2	10.68	0.075				+	+				
Striped Burrfish	1	14.02	0.185				+					
Striped Mullet	57	897.87	97.577		+	+	+	+	+	+	+	+
Strongtooth Mud Crab	1	1.08	0.001		+							
Thinstripe Hermit Crab	7	0.00	2.984					+	+	+	+	
Threadfin Shad	140	15,950.21	166.124	+	+	+	+	+	+	+	+	+
Tidewater Mojarra	4	10.82	0.103							+	+	+
Turtle Grass	1	0.00	0.002				+					
Unidentified Anemone	3	0.00	0.087									+
Unidentified Barnacle	1	0.00	0.026				+					
Unidentified Clupeid	2	65.95	0.053						+			
Unidentified Clupeid	2	65.95	0.053						+			
Unidentified Cockle	2	0.00	0.101			+						
Unidentified Crab	1	0.00	0.015					+				
Unidentified Fish	36	0.00	2.357	+	+	+	+	+	+	+	+	+
Unidentified Goby	1	0.00	0.005		+							

Table 11 (continued):

Common Name	# Tows	#/hr/net	kg/hr/net	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV
Unidentified Isopod	2	16.58	0.002				+					
Unidentified Jellyfish	152	0.00	85.306			+	+	+	+	+	+	+
Unidentified Mojarra ( <i>Eucinostomus spp.</i> )	2	28.42	0.140							+		+
Unidentified Mollusk	1	0.00	0.004			+						
Unidentified Portunid Crab ( <i>Portunus spp.</i> )	2	7.77	0.015							+		
Unidentified Seatrout ( <i>Cynoscion spp.</i> )	1	13.18	0.001					+				
Unidentified Shells	39	0.00	12.791		+	+	+	+	+	+	+	+
Unidentified Shrimp Eel	1	7.58	0.006									+
Unidentified Snapping Shrimp ( <i>Alpheus spp.</i> )	1	5.16	0.010									+
Unidentified Species	3	0.00	0.752		+	+						
Unidentified Sponge	3	0.00	0.077				+	+				
Unidentified Tellin	4	0.00	0.141				+					
Unidentified Xanthid Crab	1	0.00	0.008							+		
Violet Goby	2	28.79	0.501							+		
White Mullet	20	1,675.33	30.393						+	+	+	+
White Shrimp	284	1,052,667.66	3,106.095	+	+	+	+	+	+	+	+	+
Xanthid Mud Crab	1	1.20	0.002							+		
TOTALS:	291 tows sampled			36	61	62	86	77	67	73	79	87



**Table 12. Mean monthly catch per unit effort (CPUE) by number and biomass for all species captured in Galveston Bay during March-November 1992. Species ranked by number CPUE. Numbers in parentheses represent standard deviation. Common names follow American Fisheries Society standards (Turgeon et al. 1988, Williams et al. 1988, Robins et al. 1991).**

<b>DATA FOR MARCH 1992</b>		<b>Mean Catch Per Unit Effort (CPUE)</b>			
<b>Common Name</b>		<b>Number/hr/net</b>		<b>Kilograms/hr/net</b>	
Atlantic Croaker		3396.27	(3835.5)	19.2709	(21.9974)
Threadfin Shad		1300.67	(2704.4)	8.1667	(16.5876)
Roughback Shrimp		1116.16	(2430.9)	1.3393	(2.9273)
Gulf Menhaden		840.71	(517.7)	11.8499	(5.0585)
Cutlassfish		755.09	(1051.3)	11.6993	(16.6647)
White Shrimp		560.05	(245.1)	1.4403	(0.5726)
Bay Anchovy		234.57	(275.1)	0.4875	(0.7948)
Sand Seatrout		232.48	(317.0)	3.7420	(5.4814)
Blue Crab		149.42	(70.1)	3.1780	(2.1164)
Bighead Searobin		113.84	(144.0)	0.5260	(0.6550)
Brown Shrimp		57.66	(47.3)	0.2381	(0.1745)
Atlantic Spadefish		55.67	(69.9)	0.8676	(1.1139)
Southern Hake		49.32	(46.5)	2.2121	(1.8395)
Mantis Shrimp		46.64	(102.3)	0.1889	(0.4155)
Pink Shrimp		43.46	(34.7)	0.1647	(0.1594)
Hardhead Catfish		33.12	(35.3)	0.5995	(0.6545)
Spot		16.07	(11.2)	0.3810	(0.2607)
Silver Seatrout		5.04	(11.3)	0.0715	(0.1600)
Fringed Flounder		4.53	(6.8)	0.0184	(0.0263)
Spotted Seatrout		4.27	(9.6)	0.0867	(0.1938)
Silver Perch		3.45	(5.0)	0.0745	(0.1277)
Gulf Butterfish		3.45	(3.4)	0.0245	(0.0234)
Blackwing Searobin		3.06	(6.8)	0.0067	(0.0151)
Ocellated Flounder		2.19	(3.3)	0.0142	(0.0208)
Bay Whiff		1.99	(2.9)	0.0251	(0.0453)
Least Puffer		1.99	(2.9)	0.0311	(0.0438)
Gafftopsail Catfish		1.26	(2.8)	0.0582	(0.1301)
Gizzard Shad		0.73	(1.6)	0.0128	(0.0286)
Bluefish		0.73	(1.6)	0.0179	(0.0399)
Southern Kingfish		0.73	(1.6)	0.1601	(0.3579)
Inshore Lizardfish		0.73	(1.6)	0.0315	(0.0704)
Daggerblade Grass Shrimp		0.61	(1.4)	0.0002	(0.0004)
Unidentified Penaeid Shrimp		0.61	(1.4)	0.0009	(0.0020)
Debris		0.00	(0.0)	0.0384	(0.0533)
Unidentified Fish		0.00	(0.0)	0.0119	(0.0266)

Table 12 (continued):

DATA FOR APRIL 1992		Mean Catch Per Unit Effort (CPUE)			
Common Name		Number/hr/net		Kilograms/hr/net	
	Atlantic Croaker	3818.68	(6122.6)	17.5144	(22.7711)
	Gulf Menhaden	3422.26	(10338.0)	26.5606	(46.6766)
	White Shrimp	685.06	(610.3)	3.7617	(4.0962)
	Bay Anchovy	351.14	(547.5)	0.7715	(1.3699)
	Cutlassfish	331.80	(609.8)	6.4614	(11.6456)
	Sand Seatrout	171.61	(217.3)	2.9816	(3.9837)
	Blue Catfish	123.97	(214.5)	5.2520	(9.2325)
	Threadfin Shad	122.89	(291.7)	1.3654	(3.4986)
	Hardhead Catfish	93.73	(127.4)	2.0282	(2.4978)
	Blue Crab	82.74	(109.9)	1.3405	(1.6134)
	Spot	78.22	(166.2)	0.9555	(1.2954)
	Brown Shrimp	61.86	(97.5)	0.1267	(0.2368)
	Ohio Shrimp	52.30	(66.8)	0.1200	(0.1574)
	Roughback Shrimp	38.07	(105.8)	0.0561	(0.1527)
	Parasitic Isopod	21.88	(49.6)	0.0060	(0.0136)
	Bighead Searobin	11.73	(28.6)	0.0701	(0.1843)
	Southern Hake	9.64	(26.9)	0.4372	(1.1904)
	Mantis Shrimp	8.04	(22.7)	0.0507	(0.1454)
	Gafftopsail Catfish	7.51	(19.8)	0.5002	(1.2741)
	Pink Shrimp	5.67	(14.9)	0.0243	(0.0636)
	Spotted Seatrout	4.65	(10.3)	0.2934	(0.6191)
	Striped Mullet	4.22	(10.2)	1.1583	(3.3975)
	Gulf Butterfish	3.96	(14.7)	0.0439	(0.1738)
	Atlantic Midshipman	3.88	(11.4)	0.0779	(0.2745)
	Southern Flounder	2.93	(7.0)	0.5051	(1.5501)
	Harvestfish	2.27	(7.4)	0.0776	(0.2512)
	Silver Perch	2.08	(6.8)	0.0673	(0.2116)
	Atlantic Spadefish	2.04	(5.5)	0.0752	(0.2450)
	Hogchoker	1.85	(4.2)	0.0170	(0.0411)
	Star Drum	1.37	(4.0)	0.0146	(0.0420)
	Least Puffer	1.35	(4.9)	0.0138	(0.0714)
	Brackish Grass Shrimp	1.34	(7.4)	0.0003	(0.0015)
	Silver Seatrout	1.16	(3.5)	0.0137	(0.0401)
	Southern Kingfish	0.87	(3.0)	0.0450	(0.1604)
	Clown Goby	0.82	(4.5)	0.0002	(0.0014)
	Bay Whiff	0.79	(2.8)	0.0023	(0.0080)
	Unidentified Grass Shrimp	0.70	(3.8)	0.0001	(0.0008)
	Pinfish	0.64	(2.3)	0.0304	(0.1142)
	Fringed Flounder	0.55	(1.9)	0.0029	(0.0117)
	Gizzard Shad	0.52	(1.4)	0.0514	(0.1689)
	Pigfish	0.47	(2.6)	0.0329	(0.1803)
	Daggerblade Grass Shrimp	0.37	(2.0)	0.0001	(0.0004)
	Sheephead	0.34	(1.4)	0.3129	(1.3138)
	Atlantic Rangia	0.27	(1.5)	4.5544	(24.4476)
	Atlantic Mud Crab	0.26	(1.4)	0.0001	(0.0003)
	Black Drum	0.26	(1.4)	0.0390	(0.2139)
	Atlantic Brief Squid	0.23	(0.7)	0.0023	(0.0092)
	Highfin Goby	0.20	(1.1)	0.0018	(0.0097)
	Gulf Toadfish	0.18	(1.0)	0.0270	(0.1480)
	Blackwing Searobin	0.11	(0.6)	0.0002	(0.0011)

Table 12 (continued):

DATA FOR APRIL 1992 (cont.)		Mean Catch Per Unit Effort (CPUE)			
Common Name		Number/hr/net		Kilograms/hr/net	
Lesser Rock Shrimp		0.11	(0.6)	0.0002	(0.0009)
Blackcheek Tonguefish		0.11	(0.6)	0.0002	(0.0009)
Florida Rocksnail		0.11	(0.6)	0.0002	(0.0010)
Banded Drum		0.04	(0.2)	0.0002	(0.0011)
Strongtooth Mud Crab		0.04	(0.2)	0.0000	(0.0002)
American Oyster		0.00	(0.0)	0.0765	(0.2379)
Debris		0.00	(0.0)	0.6089	(0.8701)
Unidentified Fish		0.00	(0.0)	0.0064	(0.0353)
Unidentified Goby		0.00	(0.0)	0.0002	(0.0009)
Unidentified Shells		0.00	(0.0)	0.0228	(0.1248)
Unidentified Sponge		0.00	(0.0)	0.0025	(0.0133)



Table 12 (continued):

DATA FOR MAY 1992	Mean Catch Per Unit Effort (CPUE)			
	Common Name		Number/hr/net	Kilograms/hr/net
	Brown Shrimp	7813.45	(9822.4)	15.0714 (19.7267)
	Atlantic Croaker	1487.79	(2344.2)	17.6951 (38.2831)
	Cutlassfish	1210.32	(2495.1)	50.0040 (110.1639)
	Gulf Menhaden	689.74	(1097.1)	7.4323 (13.8680)
	White Shrimp	260.72	(312.7)	2.8574 (3.9623)
	Atlantic Brief Squid	190.93	(513.8)	2.4869 (7.0580)
	Sand Seatrout	128.76	(140.0)	1.1954 (1.4220)
	Blue Catfish	118.84	(291.9)	3.8957 (8.8171)
	Blue Crab	102.18	(151.6)	2.8684 (4.1306)
	Hardhead Catfish	75.62	(209.3)	3.0460 (9.2711)
	Bay Anchovy	66.33	(89.7)	0.0620 (0.0802)
	Spot	54.24	(120.3)	0.5279 (0.8931)
	Roughback Shrimp	34.58	(108.4)	0.0647 (0.2041)
	Gizzard Shad	29.50	(54.5)	0.6134 (1.0864)
	Banded Drum	24.66	(65.8)	0.4555 (1.6448)
	Threadfin Shad	21.49	(59.0)	0.2829 (0.7932)
	Atlantic Spadefish	20.16	(77.9)	0.4068 (1.5877)
	Sergestid Shrimp	19.63	(75.6)	0.0008 (0.0029)
	Pinfish	11.72	(38.4)	0.4104 (1.3527)
	Blackwing Searobin	10.55	(28.4)	0.0343 (0.1104)
	Mantis Shrimp	8.05	(24.8)	0.0559 (0.1698)
	Ohio Shrimp	7.05	(17.9)	0.0128 (0.0320)
	Inshore Lizardfish	6.38	(25.4)	0.1407 (0.6048)
	Parasitic Isopod	6.16	(17.0)	0.0012 (0.0035)
	Bighead Searobin	5.34	(12.2)	0.0501 (0.1407)
	Atlantic Midshipman	4.85	(14.3)	0.1157 (0.3753)
	Harvestfish	4.61	(10.8)	0.0223 (0.0670)
	Pigfish	3.21	(10.3)	0.2471 (0.7991)
	Longnose Spider Crab	3.09	(13.5)	0.0005 (0.0026)
	Bay Whiff	2.13	(6.6)	0.0078 (0.0387)
	Least Puffer	2.13	(6.1)	0.0120 (0.0460)
	Lesser Blue Crab	1.26	(4.5)	0.0125 (0.0438)
	Southern Flounder	1.10	(3.1)	0.0499 (0.1445)
	Gulf Toadfish	0.98	(4.2)	0.0328 (0.1178)
	Spotted Seatrout	0.98	(2.5)	0.0831 (0.2300)
	Gulf Butterfish	0.87	(3.2)	0.0134 (0.0769)
	Southern Kingfish	0.82	(4.9)	0.0426 (0.2556)
	Hogchoker	0.70	(3.1)	0.0166 (0.0669)
	Fringed Flounder	0.56	(2.0)	0.0043 (0.0158)
	Striped Mullet	0.54	(2.0)	0.0746 (0.3164)
	Silver Perch	0.49	(2.2)	0.0136 (0.0583)
	Gafftopsail Catfish	0.46	(2.1)	0.0462 (0.2251)
	Silver Seatrout	0.32	(1.9)	0.0109 (0.0655)
	Bluefish	0.31	(1.6)	0.0292 (0.1616)
	Pink Shrimp	0.26	(1.6)	0.0017 (0.0101)
	Shrimp Eel	0.26	(1.6)	0.0223 (0.1336)
	Southern Hake	0.26	(1.1)	0.0107 (0.0448)
	Marsh Grass Shrimp	0.25	(1.5)	0.0001 (0.0003)
	Atlantic Threadfin	0.13	(0.8)	0.0014 (0.0082)
	Blackcheek Tonguefish	0.13	(0.8)	0.0005 (0.0028)

Table 12 (continued):

DATA FOR MAY 1992 (cont.)		Mean Catch Per Unit Effort (CPUE)			
Common Name		Number/hr/net		Kilograms/hr/net	
	Black Drum	0.06	(0.4)	0.0133	(0.0800)
	Sheephead	0.05	(0.3)	0.0032	(0.0190)
	American Oyster	0.00	(0.0)	0.0406	(0.1380)
	Angelwing	0.00	(0.0)	0.0035	(0.0112)
	Debris	0.00	(0.0)	1.0343	(2.9089)
	Moon Snail	0.00	(0.0)	0.0000	(0.0000)
	Atlantic Rangia	0.00	(0.0)	3.7971	(22.3035)
	Sargassum Seaweed	0.00	(0.0)	0.0374	(0.1363)
	Unidentified Cockle	0.00	(0.0)	0.0028	(0.0138)
	Unidentified Fish	0.00	(0.0)	0.0015	(0.0045)
	Unidentified Jellyfish	0.00	(0.0)	0.5221	(1.2941)
	Unidentified Mollusk	0.00	(0.0)	0.0001	(0.0007)
	Unidentified Shells	0.00	(0.0)	0.0004	(0.0025)
	Unidentified Species	0.00	(0.0)	0.0001	(0.0003)

Table 12 (continued):

DATA FOR JUNE 1992		Mean Catch Per Unit Effort (CPUE)			
Common Name		Number/hr/net		Kilograms/hr/net	
	Brown Shrimp	13113.70	(12864.8)	24.6534	(26.4090)
	Spot	1507.79	(3056.8)	12.8241	(23.2053)
	Sergestid Shrimp	1464.24	(8765.3)	0.0961	(0.5771)
	Atlantic Croaker	988.05	(1018.0)	8.8522	(7.3204)
	Gulf Menhaden	504.09	(880.6)	6.4914	(11.6177)
	Sand Seatrout	447.41	(540.2)	4.9073	(6.7716)
	White Shrimp	352.21	(1006.0)	1.2784	(1.9758)
	Cutlassfish	306.54	(479.8)	20.6267	(35.3861)
	Blue Crab	148.56	(193.2)	4.6243	(7.2454)
	Bay Anchovy	98.96	(124.0)	0.0625	(0.0757)
	Atlantic Brief Squid	60.53	(105.7)	0.6264	(1.3998)
	Hardhead Catfish	53.18	(67.0)	2.5647	(5.0537)
	Harvestfish	42.06	(76.9)	0.6801	(1.6767)
	Bay Whiff	27.77	(47.4)	0.0826	(0.1152)
	Threadfin Shad	21.75	(52.6)	0.3174	(0.8302)
	Roughback Shrimp	19.98	(62.1)	0.0040	(0.0133)
	Lesser Blue Crab	19.34	(58.5)	0.0382	(0.1140)
	Pinfish	18.04	(77.9)	0.3428	(1.3251)
	Inshore Lizardfish	15.21	(32.7)	0.4457	(1.2694)
	Silver Seatrout	14.67	(38.7)	0.5652	(1.4886)
	Least Puffer	14.36	(25.1)	0.0344	(0.0679)
	Atlantic Midshipman	11.18	(27.9)	0.4004	(1.3770)
	Parasitic Isopod	11.05	(19.2)	0.0020	(0.0041)
	Gulf Butterfish	9.65	(29.7)	0.3313	(1.0619)
	Banded Drum	9.16	(22.2)	0.2369	(0.6365)
	Gafftopsail Catfish	8.81	(25.6)	0.7880	(2.5586)
	Atlantic Spadefish	8.67	(34.5)	0.5335	(2.8707)
	Star Drum	7.33	(43.7)	0.0180	(0.1078)
	Bighead Searobin	6.24	(10.8)	0.1202	(0.2899)
	Striped Anchovy	6.19	(28.4)	0.0203	(0.0917)
	Atlantic Bumper	5.90	(19.9)	0.2387	(0.8516)
	Silver Perch	5.67	(18.2)	0.2831	(0.9839)
	Spanish Mackerel	4.01	(7.5)	0.2282	(0.7426)
	Atlantic Threadfin	3.87	(10.5)	0.0631	(0.1991)
	Gizzard Shad	3.79	(9.1)	0.1375	(0.3401)
	Fringed Flounder	3.60	(7.9)	0.0219	(0.0734)
	Hogchoker	2.82	(10.6)	0.0379	(0.1877)
	Brackish Grass Shrimp	2.82	(9.9)	0.0004	(0.0016)
	Atlantic Stingray	2.29	(8.3)	0.6992	(3.3638)
	Southern Kingfish	2.27	(5.7)	0.2020	(0.4911)
	Highfin Goby	2.23	(13.6)	0.0712	(0.4331)
	Blackwing Searobin	2.15	(10.8)	0.0078	(0.0376)
	Southern Flounder	1.90	(3.6)	0.1845	(0.3664)
	Pigfish	1.71	(6.1)	0.1763	(0.6385)
	Harris Mud Crab	1.71	(5.6)	0.2539	(0.8361)
	Mantis Shrimp	1.69	(5.3)	0.0018	(0.0062)
	Ohio Shrimp	1.67	(7.9)	0.0007	(0.0031)
	Striped Mullet	1.41	(4.2)	0.2339	(0.6332)
	Gulf Toadfish	1.20	(5.1)	0.0785	(0.3753)
	Blackcheek Tonguefish	1.16	(4.4)	0.0101	(0.0380)



Table 12 (continued):

DATA FOR JUNE 1992 (cont.)	Mean Catch Per Unit Effort (CPUE)			
	Number/hr/net		Kilograms/hr/net	
Iridescent Swimming Crab	1.12	(5.0)	0.0032	(0.0166)
Blue Catfish	0.95	(4.3)	0.0333	(0.1636)
Scalloped Hammerhead	0.80	(4.9)	0.3111	(1.8923)
Lookdown	0.70	(2.2)	0.0024	(0.0083)
Unidentified Isopod	0.45	(2.3)	0.0000	(0.0002)
Spotted Seatrout	0.45	(2.3)	0.0987	(0.5319)
Marsh Grass Shrimp	0.43	(2.6)	0.0000	(0.0003)
Unidentified Grass Shrimp	0.42	(2.6)	0.0000	(0.0003)
Striped Burrfish	0.38	(2.3)	0.0050	(0.0304)
Calico Box Crab	0.38	(2.3)	0.0045	(0.0277)
Dwarf Herring	0.37	(2.3)	0.0001	(0.0007)
Rock Sea Bass	0.37	(2.3)	0.0051	(0.0309)
Black Drum	0.25	(0.9)	0.0495	(0.1714)
Ocellated Flounder	0.24	(1.5)	0.0287	(0.1747)
Daggerblade Grass Shrimp	0.22	(1.3)	0.0000	(0.0003)
Atlantic Mud Crab	0.22	(1.3)	0.0000	(0.0003)
Spotfin Mojarra	0.21	(1.3)	0.0037	(0.0224)
Striped Blenny	0.15	(0.9)	0.0012	(0.0074)
Blacktip Shark	0.14	(0.8)	0.1154	(0.7021)
Pipefish	0.09	(0.5)	0.0000	(0.0002)
Cownose Ray	0.08	(0.5)	0.0261	(0.1590)
Blood Ark (Clam)	0.00	(0.0)	0.0108	(0.0417)
Common Barnacle	0.00	(0.0)	0.0001	(0.0004)
Perverse Whelk	0.00	(0.0)	0.0007	(0.0043)
American Oyster	0.00	(0.0)	0.7189	(2.2624)
Angelwing	0.00	(0.0)	0.0168	(0.0501)
Debris	0.00	(0.0)	0.1475	(0.3104)
Sargassum Seaweed	0.00	(0.0)	0.0041	(0.0245)
Turtle Grass	0.00	(0.0)	0.0000	(0.0003)
Unidentified Barnacle	0.00	(0.0)	0.0007	(0.0042)
Unidentified Fish	0.00	(0.0)	0.0087	(0.0428)
Unidentified Jellyfish	0.00	(0.0)	0.1576	(0.5229)
Unidentified Shells	0.00	(0.0)	0.0108	(0.0470)
Unidentified Sponge	0.00	(0.0)	0.0196	(0.0951)
Unidentified Tellin	0.00	(0.0)	0.0038	(0.0138)
Gulf Oyster Drill	0.00	(0.0)	0.0014	(0.0088)

Table 12 (continued):

DATA FOR JULY 1992		Mean Catch Per Unit Effort (CPUE)			
Common Name		Number/hr/net		Kilograms/hr/net	
	Brown Shrimp	1853.50	(3530.6)	4.3956	(6.8155)
	White Shrimp	952.12	(1880.4)	2.9185	(5.6686)
	Atlantic Croaker	504.95	(717.9)	5.1939	(4.7994)
	Gulf Menhaden	290.81	(429.2)	2.9271	(4.2404)
	Sand Seatrout	277.37	(233.8)	3.1130	(3.0663)
	Spot	200.86	(226.0)	2.5481	(2.9197)
	Bay Anchovy	197.85	(316.9)	0.1228	(0.1890)
	Cutlassfish	171.12	(188.0)	4.2700	(5.9415)
	Atlantic Brief Squid	119.76	(189.4)	0.6424	(0.7797)
	Gafftopsail Catfish	99.84	(120.9)	0.9956	(1.2997)
	Hardhead Catfish	89.01	(103.6)	1.8283	(2.1211)
	Roughback Shrimp	83.75	(175.5)	0.0393	(0.0824)
	Bay Whiff	65.45	(142.0)	0.2716	(0.5422)
	Harvestfish	47.22	(65.3)	1.0113	(1.3731)
	Star Drum	43.56	(157.1)	0.1198	(0.3448)
	Least Puffer	36.73	(64.6)	0.1064	(0.2249)
	Atlantic Midshipman	29.92	(80.8)	0.7664	(2.5564)
	Threadfin Shad	28.35	(52.3)	0.3377	(0.6387)
	Fringed Flounder	26.53	(45.7)	0.0909	(0.1486)
	Mantis Shrimp	19.14	(49.9)	0.1301	(0.5726)
	Parasitic Isopod	18.35	(53.9)	0.0039	(0.0159)
	Unidentified Grass Shrimp	17.07	(63.8)	0.0024	(0.0084)
	Gizzard Shad	15.46	(49.2)	0.2419	(0.7131)
	Lesser Blue Crab	13.59	(34.5)	0.0617	(0.1890)
	Bighead Searobin	11.61	(23.1)	0.1207	(0.3033)
	Striped Anchovy	11.33	(35.2)	0.0511	(0.1683)
	Inshore Lizardfish	8.66	(12.0)	0.1797	(0.2684)
	Atlantic Spadefish	6.76	(11.4)	0.1481	(0.3565)
	Blackwing Searobin	6.64	(20.7)	0.0254	(0.0875)
	Hogchoker	6.39	(20.0)	0.1073	(0.3334)
	Seabob	5.98	(13.6)	0.0142	(0.0335)
	Silver Perch	5.60	(33.2)	0.0340	(0.1500)
	Striped Mullet	5.51	(17.9)	0.2871	(0.8191)
	Daggerblade Grass Shrimp	4.83	(31.3)	0.0004	(0.0025)
	Spanish Mackerel	4.68	(11.8)	0.1418	(0.3533)
	Sergestid Shrimp	4.57	(15.8)	0.0005	(0.0024)
	Pinfish	3.43	(8.2)	0.1240	(0.3238)
	Southern Kingfish	3.24	(12.5)	0.1010	(0.3890)
	Gulf Toadfish	3.03	(10.6)	0.2362	(0.8631)
	Crevalle Jack	2.23	(9.6)	0.0358	(0.1716)
	Longnose Spider Crab	2.18	(14.1)	0.0017	(0.0113)
	Atlantic Bumper	1.81	(5.7)	0.0118	(0.0403)
	Lookdown	1.52	(4.1)	0.0086	(0.0405)
	Ladyfish	1.46	(4.4)	0.0838	(0.2517)
	Atlantic Threadfin	1.35	(4.9)	0.0555	(0.1949)
	Southern Flounder	1.27	(3.8)	0.2067	(0.6515)
	Banded Drum	1.20	(4.0)	0.0003	(0.0011)
	Moonfish	0.96	(3.9)	0.0018	(0.0069)
	Sharptail Goby	0.65	(4.2)	0.0064	(0.0415)
	Atlantic Stingray	0.64	(2.4)	0.0840	(0.2698)

Table 12 (continued):

DATA FOR JULY 1992 (cont.)		Mean Catch Per Unit Effort (CPUE)			
Common Name		Number/hr/net		Kilograms/hr/net	
	Sheephead	0.50	(2.0)	0.0882	(0.3751)
	Debris	0.43	(2.8)	0.8252	(3.1991)
	Guaguanche	0.38	(2.0)	0.0007	(0.0038)
	Atlantic Mud Crab	0.35	(1.8)	0.0014	(0.0061)
	Gulf Butterfish	0.33	(1.7)	0.0059	(0.0360)
	Shrimp Eel	0.30	(2.0)	0.1543	(0.3860)
	Unidentified Seatrout	0.31	(2.0)	0.0000	(0.0002)
	Blackcheek Tonguefish	0.21	(1.0)	0.0027	(0.0115)
	Ohio Shrimp	0.17	(1.1)	0.0000	(0.0002)
	Striped Blenny	0.12	(0.8)	0.0007	(0.0046)
	Mud Crab	0.11	(1.0)	0.0000	(0.0001)
	Flatback Mud Crab	0.06	(0.4)	0.0000	(0.0001)
	Florida Stone Crab	0.06	(0.4)	0.0001	(0.0007)
	Pigfish	0.05	(0.3)	0.0041	(0.0269)
	Bent Mussel	0.00	(0.0)	0.0007	(0.0045)
	Thinstripe Hermit Crab	0.00	(0.0)	0.0473	(0.3065)
	American Oyster	0.00	(0.0)	1.0646	(2.8409)
	Hooked Mussel	0.00	(0.0)	0.0002	(0.0015)
	Moon Snail	0.00	(0.0)	0.0059	(0.0293)
	Sargassum Seaweed	0.00	(0.0)	0.0083	(0.0343)
	Red Drum	0.00	(0.0)	0.0001	(0.0009)
	Purplish Tagelus	0.00	(0.0)	0.0007	(0.0042)
	Unidentified Crab	0.00	(0.0)	0.0004	(0.0024)
	Unidentified Fish	0.00	(0.0)	0.0125	(0.0488)
	Unidentified Jellyfish	0.00	(0.0)	0.0362	(0.0957)
	Unidentified Shells	0.00	(0.0)	0.1322	(0.5818)
	Unidentified Sponge	0.00	(0.0)	0.0007	(0.0042)



Table 12 (continued):

DATA FOR AUGUST 1992		Mean Catch Per Unit Effort (CPUE)			
Common Name		Number/hr/net		Kilograms/hr/net	
	White Shrimp	5726.37	(9436.1)	19.6158	(25.2125)
	Gulf Menhaden	2619.09	(4525.9)	20.3737	(32.8217)
	Brown Shrimp	793.98	(1170.5)	1.3271	(1.9367)
	Atlantic Croaker	527.97	(427.0)	5.3644	(3.7945)
	Hardhead Catfish	402.92	(683.6)	2.2218	(3.3610)
	Spot	282.20	(593.1)	3.9932	(8.0248)
	Bay Anchovy	214.99	(411.0)	0.0904	(0.1339)
	Sand Seatrout	212.79	(337.3)	3.0551	(3.6365)
	Bay Whiff	178.53	(336.5)	0.8695	(1.4370)
	Atlantic Brief Squid	115.47	(163.8)	0.6859	(1.0005)
	Gafftopsail Catfish	64.76	(111.6)	1.8736	(3.1567)
	White Mullet	51.83	(160.0)	0.8995	(3.0962)
	Blue Crab	46.04	(64.3)	1.6339	(2.4024)
	Gizzard Shad	33.95	(104.4)	0.4446	(0.9978)
	Cutlassfish	27.13	(45.6)	0.8616	(1.2848)
	Threadfin Shad	25.22	(33.3)	0.4030	(0.5140)
	Fringed Flounder	21.64	(45.7)	0.1381	(0.3190)
	Atlantic Bumper	17.92	(84.2)	0.0587	(0.2693)
	Roughback Shrimp	17.30	(44.6)	0.0085	(0.0188)
	Star Drum	13.39	(36.0)	0.0606	(0.1469)
	Hogchoker	9.06	(23.2)	0.0669	(0.1571)
	Harvestfish	8.47	(10.7)	0.2332	(0.4201)
	Parasitic Isopod	8.30	(9.9)	0.0009	(0.0011)
	Pinfish	8.20	(16.4)	0.1636	(0.3487)
	Spanish Mackerel	7.93	(12.6)	0.2832	(0.5109)
	Mantis Shrimp	7.61	(19.2)	0.0226	(0.0654)
	Least Puffer	7.12	(12.3)	0.0268	(0.0476)
	Striped Anchovy	6.55	(19.2)	0.0411	(0.1143)
	Striped Mullet	6.36	(11.8)	0.5960	(1.3189)
	Atlantic Spadefish	6.02	(8.5)	0.0826	(0.1542)
	Lesser Blue Crab	5.80	(12.6)	0.0122	(0.0256)
	Bluntnose Jack	4.66	(9.3)	0.0189	(0.0362)
	Bighead Searobin	3.47	(6.9)	0.0256	(0.0550)
	Creville Jack	3.01	(5.1)	0.0932	(0.1848)
	Inshore Lizardfish	3.00	(8.1)	0.0910	(0.2661)
	Anchovy	2.36	(11.5)	0.0019	(0.0095)
	Atlantic Stingray	2.10	(5.2)	0.3613	(1.3245)
	Atlantic Midshipman	2.02	(4.8)	0.0613	(0.1546)
	Southern Flounder	1.74	(6.7)	0.2218	(1.0406)
	Silver Perch	1.34	(6.6)	0.0088	(0.0446)
	Shrimp Eel	1.25	(6.6)	0.0751	(0.3973)
	Daggerblade Grass Shrimp	1.25	(6.6)	0.0001	(0.0003)
	Ladyfish	1.13	(3.3)	0.2033	(0.6934)
	Southern Kingfish	0.88	(3.4)	0.0514	(0.2550)
	Unidentified Grass Shrimp	0.71	(3.8)	0.0001	(0.0004)
	Scaled Sardine	0.63	(3.3)	0.0014	(0.0073)
	Highfin Goby	0.49	(1.8)	0.0069	(0.0260)
	Black Drum	0.47	(1.5)	0.0979	(0.3451)
	Seabob	0.45	(2.4)	0.0006	(0.0033)
	Horse-Eye Jack	0.35	(1.8)	0.0035	(0.0187)

Table 12 (continued):

DATA FOR AUGUST 1992 (cont.)		Mean Catch Per Unit Effort (CPUE)			
Common Name		Number/hr/net		Kilograms/hr/net	
Longnose Spider Crab		0.29	(1.5)	0.0000	(0.0002)
Lookdown		0.22	(0.9)	0.0026	(0.0096)
Spotted Seatrout		0.21	(0.8)	0.0533	(0.1956)
Blackcheek Tonguefish		0.18	(1.0)	0.0010	(0.0051)
Spotfin Mojarra		0.09	(0.5)	0.0006	(0.0033)
Moonfish		0.09	(0.5)	0.0004	(0.0020)
Atlantic Thread Herring		0.05	(0.3)	0.0059	(0.0310)
Sergestid Shrimp		0.00	(0.0)	0.0000	(0.0002)
Thinstripe Hermit Crab		0.00	(0.0)	0.0048	(0.0254)
American Oyster		0.00	(0.0)	0.4600	(1.6271)
Angelwing		0.00	(0.0)	0.0011	(0.0045)
Debris		0.00	(0.0)	0.5408	(1.2762)
Atlantic Rangia		0.00	(0.0)	0.2177	(1.0875)
Sargassum Seaweed		0.00	(0.0)	0.0026	(0.0139)
Red Drum		0.00	(0.0)	0.0000	(0.0000)
Stout Tagelus		0.00	(0.0)	0.0038	(0.0200)
Unidentified Fish		0.00	(0.0)	0.0015	(0.0053)
Unidentified Jellyfish		0.00	(0.0)	0.3301	(0.4482)
Unidentified Shells		0.00	(0.0)	0.0358	(0.1043)

Table 12 (continued):

DATA FOR SEPTEMBER 1992 Common Name	Mean Catch Per Unit Effort (CPUE)			
	Number/hr/net		Kilograms/hr/net	
White Shrimp	9043.05	(18141.2)	28.6643	(46.2520)
Brown Shrimp	1030.85	(1181.5)	2.5896	(4.6685)
Atlantic Croaker	597.34	(872.5)	10.3006	(14.5023)
Bay Whiff	364.94	(684.8)	2.1155	(3.8874)
Gulf Menhaden	328.98	(975.7)	3.4460	(9.3855)
Sand Seatrout	268.33	(387.6)	5.1364	(6.6872)
Hardhead Catfish	206.99	(280.8)	1.6030	(2.2220)
Atlantic Brief Squid	197.66	(258.2)	1.9044	(2.2498)
Bay Anchovy	110.13	(141.5)	0.0981	(0.1965)
Gafftopsail Catfish	93.79	(189.4)	3.5599	(6.8710)
Spot	66.68	(139.9)	1.1996	(2.2629)
Blue Crab	42.03	(46.9)	1.5823	(1.9721)
Fringed Flounder	41.54	(51.8)	0.2293	(0.2871)
Sergestid Shrimp	34.84	(209.0)	0.0014	(0.0080)
Lesser Blue Crab	28.47	(35.8)	0.1277	(0.1734)
Cutlassfish	28.28	(60.2)	1.3814	(2.9152)
Star Drum	23.76	(40.1)	0.1457	(0.2391)
Harvestfish	21.79	(24.2)	0.1026	(0.1395)
Hogchoker	20.23	(46.7)	0.1283	(0.2591)
Mantis Shrimp	17.78	(23.7)	0.0884	(0.1336)
Roughback Shrimp	16.88	(29.7)	0.0113	(0.0201)
Inshore Lizardfish	14.67	(29.0)	0.3023	(0.5867)
Atlantic Bumper	12.41	(35.3)	0.0221	(0.0509)
Striped Anchovy	11.75	(32.4)	0.0796	(0.2236)
Scaled Sardine	11.42	(36.6)	0.0401	(0.1001)
Seabob	11.28	(33.5)	0.0146	(0.0399)
Parasitic Isopod	9.07	(13.9)	0.0022	(0.0067)
Bluntnose Jack	8.23	(9.4)	0.0612	(0.0816)
Threadfin Shad	8.19	(19.8)	0.0939	(0.2331)
Least Puffer	7.59	(13.4)	0.0342	(0.0611)
Atlantic Spadefish	7.32	(9.1)	0.0756	(0.1408)
Lined Sole	6.22	(23.5)	0.0229	(0.0946)
Atlantic Midshipman	4.40	(12.1)	0.0642	(0.1520)
Lookdown	3.98	(20.9)	0.0209	(0.0744)
Spanish Mackerel	3.08	(6.6)	0.0457	(0.1120)
Silver Perch	2.66	(9.4)	0.0392	(0.1090)
Silver Jenny	2.11	(9.3)	0.0141	(0.0635)
Atlantic Stingray	2.08	(6.6)	1.8148	(7.1730)
Pinfish	1.87	(4.8)	0.0906	(0.2547)
Flagfin Mojarra	1.69	(8.3)	0.0108	(0.0525)
Florida Stone Crab	1.29	(7.0)	0.1250	(0.6561)
Shrimp Eel	1.27	(5.4)	0.0783	(0.3281)
Blackcheek Tonguefish	1.26	(4.9)	0.0088	(0.0310)
Crevalle Jack	1.22	(6.4)	0.0373	(0.2178)
Gizzard Shad	0.88	(3.0)	0.0220	(0.0776)
Southern Kingfish	0.85	(2.7)	0.0095	(0.0309)
Bighead Searobin	0.81	(2.3)	0.0073	(0.0248)
Violet Goby	0.80	(3.5)	0.0139	(0.0632)
Spotfin Mojarra	0.75	(3.2)	0.0060	(0.0255)
Unidentified Mojarra	0.74	(4.4)	0.0036	(0.0213)



Table 12 (continued):

DATA FOR SEPTEMBER 1992 (cont.)		Mean Catch Per Unit Effort (CPUE)			
Common Name		Number/hr/net		Kilograms/hr/net	
	Moonfish	0.61	(1.6)	0.0017	(0.0048)
	Gulf Toadfish	0.56	(2.8)	0.0151	(0.0626)
	Guaguanche	0.43	(1.2)	0.0012	(0.0034)
	Rough Silverside	0.42	(2.5)	0.0013	(0.0079)
	Sheephead	0.29	(1.5)	0.0400	(0.2002)
	Gray Snapper	0.25	(1.5)	0.0037	(0.0222)
	Striped Mullet	0.23	(1.0)	0.0458	(0.2335)
	Unidentified Portunid Crab	0.22	(0.9)	0.0004	(0.0018)
	White Mullet	0.14	(0.5)	0.0034	(0.0116)
	Blackwing Searobin	0.12	(0.6)	0.0015	(0.0068)
	Ladyfish	0.05	(0.3)	0.0115	(0.0687)
	Tidewater Mojarra	0.05	(0.3)	0.0002	(0.0009)
	Iridescent Swimming Crab	0.04	(0.3)	0.0001	(0.0007)
	Xanthid Mud Crab	0.03	(0.2)	0.0001	(0.0004)
	Thinstripe Hermit Crab	0.00	(0.0)	0.0076	(0.0453)
	American Oyster	0.00	(0.0)	0.1918	(0.5313)
	Debris	0.00	(0.0)	0.5968	(1.6866)
	Moon Snail	0.00	(0.0)	0.0175	(0.0598)
	Atlantic Rangia	0.00	(0.0)	0.0204	(0.0713)
	Sargassum Seaweed	0.00	(0.0)	0.0322	(0.1385)
	Unidentified Fish	0.00	(0.0)	0.0035	(0.0109)
	Unidentified Jellyfish	0.00	(0.0)	0.5094	(0.8836)
	Unidentified Shells	0.00	(0.0)	0.0614	(0.1883)
	Unidentified Xanthid Crab	0.00	(0.0)	0.0002	(0.0013)

Table 12 (continued):

DATA FOR OCTOBER 1992 Common Name	Mean Catch Per Unit Effort (CPUE)			
	Number/hr/net		Kilograms/hr/net	
White Shrimp	2255.19	(3049.2)	10.0276	(9.6337)
Brown Shrimp	773.45	(1687.3)	2.3281	(5.5316)
Gulf Menhaden	548.71	(1048.1)	5.6401	(7.9467)
Atlantic Brief Squid	277.23	(450.4)	3.0335	(7.9774)
Atlantic Croaker	211.50	(195.1)	4.7896	(5.3745)
Sand Seatrout	155.68	(274.3)	4.3191	(7.7935)
Hardhead Catfish	130.69	(317.4)	1.8700	(5.8798)
Cutlassfish	92.31	(360.3)	2.5766	(9.9194)
Bay Anchovy	58.80	(46.2)	0.0647	(0.0616)
Harvestfish	42.69	(49.6)	0.5122	(0.6891)
Spot	37.74	(126.1)	1.0175	(3.0738)
Threadfin Shad	36.34	(83.0)	0.6483	(1.5471)
Blue Crab	34.78	(49.5)	1.1745	(1.5197)
Mantis Shrimp	28.02	(90.1)	0.2390	(0.8007)
Bay Whiff	26.26	(46.0)	0.2243	(0.3885)
Lesser Blue Crab	20.28	(36.9)	0.1277	(0.2425)
Atlantic Bumper	18.37	(50.0)	0.0464	(0.1275)
Roughback Shrimp	17.83	(44.0)	0.0134	(0.0312)
Star Drum	17.78	(74.3)	0.2143	(0.9766)
Seabob	16.58	(90.6)	0.0355	(0.1950)
Parasitic Isopod	15.97	(20.0)	0.0023	(0.0027)
Fringed Flounder	15.87	(28.1)	0.1285	(0.2557)
Inshore Lizardfish	14.56	(24.2)	0.4766	(0.6390)
Atlantic Spadefish	13.99	(25.1)	0.1167	(0.3027)
Least Puffer	8.05	(16.6)	0.0407	(0.1033)
Bluntnose Jack	8.01	(11.0)	0.0646	(0.1157)
Lookdown	7.89	(32.8)	0.0635	(0.3183)
Gafftopsail Catfish	7.18	(17.1)	0.6962	(2.0536)
Spanish Mackerel	4.93	(8.7)	0.1087	(0.2089)
Southern Kingfish	4.79	(10.6)	0.1340	(0.2793)
Moonfish	4.43	(13.9)	0.0133	(0.0424)
Scaled Sardine	4.42	(11.2)	0.0182	(0.0511)
Bighead Searobin	3.67	(6.2)	0.1066	(0.3016)
Hogchoker	2.85	(8.0)	0.0421	(0.1426)
Iridescent Swimming Crab	2.84	(12.6)	0.0149	(0.0756)
White Mullet	2.05	(10.5)	0.0471	(0.2294)
Pinfish	1.99	(5.2)	0.1018	(0.2767)
Silver Perch	1.91	(5.4)	0.0422	(0.1256)
Lined Sole	1.39	(5.0)	0.0047	(0.0155)
Banded Drum	1.28	(5.2)	0.0021	(0.0097)
Guaguanche	1.20	(4.1)	0.0088	(0.0308)
Atlantic Midshipman	1.16	(3.6)	0.0119	(0.0538)
Peppermint Shrimp	1.15	(7.3)	0.0001	(0.0007)
Gulf Toadfish	1.05	(3.8)	0.1259	(0.4712)
Flagfin Mojarra	0.98	(2.9)	0.0081	(0.0236)
Striped Anchovy	0.87	(2.1)	0.0094	(0.0228)
Pink Shrimp	0.80	(4.4)	0.0034	(0.0173)
Lesser Rock Shrimp	0.76	(3.3)	0.0003	(0.0014)
Gulf Butterfish	0.75	(3.0)	0.0025	(0.0112)
Rough Silverside	0.73	(3.8)	0.0014	(0.0074)

Table 12 (continued):

DATA FOR OCTOBER 1992 (cont.)		Mean Catch Per Unit Effort (CPUE)			
Common Name		Number/hr/net		Kilograms/hr/net	
Southern Flounder		0.64	(4.0)	0.1271	(0.8037)
Striped Mullet		0.51	(1.1)	0.1390	(0.3363)
Black Drum		0.48	(2.4)	0.3344	(1.4778)
Atlantic Sharpnose Shark		0.35	(2.2)	0.0000	(0.0002)
Silver Jenny		0.35	(1.3)	0.0023	(0.0092)
Blackwing Searobin		0.20	(1.0)	0.0058	(0.0265)
Unidentified Grass Shrimp		0.19	(1.2)	0.0000	(0.0002)
Rock Sea Bass		0.17	(0.7)	0.0045	(0.0199)
Blackcheek Tonguefish		0.16	(0.7)	0.0007	(0.0029)
Leatherjack		0.13	(0.8)	0.0009	(0.0060)
Crevalle Jack		0.09	(0.6)	0.0019	(0.0121)
Tidewater Mojarra		0.09	(0.5)	0.0014	(0.0090)
Gray Snapper		0.09	(0.5)	0.0017	(0.0108)
Planehead Filefish		0.08	(0.5)	0.0002	(0.0010)
Spotted Seatrout		0.08	(0.5)	0.0001	(0.0004)
Sheephead		0.08	(0.5)	0.0021	(0.0131)
Atlantic Stingray		0.05	(0.3)	0.0098	(0.0485)
Gizzard Shad		0.05	(0.3)	0.0013	(0.0082)
Mud Crab		0.04	(0.4)	0.0001	(0.0012)
Blotched Swimming Crab		0.03	(0.2)	0.0004	(0.0026)
Thinstripe Hermit Crab		0.00	(0.0)	0.0148	(0.0529)
American Oyster		0.00	(0.0)	0.4796	(2.0099)
Debris		0.00	(0.0)	0.2535	(0.5234)
Florida Stone Crab		0.00	(0.0)	0.0000	(0.0001)
Pagurid Hermit Crab		0.00	(0.0)	0.0030	(0.0149)
Sargassum Seaweed		0.00	(0.0)	0.0002	(0.0015)
Unidentified Fish		0.00	(0.0)	0.0000	(0.0001)
Unidentified Jellyfish		0.00	(0.0)	0.7598	(2.0978)
Unidentified Shells		0.00	(0.0)	0.0700	(0.3292)



Table 12 (continued):

DATA FOR NOVEMBER 1992		Mean Catch Per Unit Effort (CPUE)			
Common Name		Number/hr/net		Kilograms/hr/net	
	White Shrimp	10855.93	(20796.0)	20.3065	(31.0162)
	Gulf Menhaden	1077.32	(2133.6)	7.5629	(14.1894)
	Bay Anchovy	511.38	(1293.6)	0.6898	(1.8772)
	Roughback Shrimp	442.49	(1125.7)	0.3192	(0.7175)
	Atlantic Brief Squid	268.37	(397.9)	1.9881	(3.8258)
	Brown Shrimp	264.48	(349.2)	0.7239	(0.8938)
	Sand Seatrout	204.50	(234.6)	4.4263	(6.1574)
	Atlantic Croaker	194.80	(283.5)	6.0041	(9.6164)
	Mantis Shrimp	159.97	(289.7)	1.2160	(2.2909)
	Fringed Flounder	127.65	(170.3)	0.8342	(1.1545)
	Lesser Blue Crab	103.18	(174.2)	0.4352	(0.7401)
	Silver Perch	76.52	(264.5)	1.2711	(4.1794)
	Bighead Searobin	69.79	(111.5)	0.9109	(1.8364)
	Spot	68.32	(185.2)	1.5178	(3.8819)
	Blue Crab	57.68	(71.8)	1.6668	(1.8608)
	Inshore Lizardfish	49.68	(38.6)	2.5997	(2.8918)
	Hardhead Catfish	42.71	(76.0)	0.4657	(0.7398)
	Bay Whiff	38.31	(45.8)	0.2954	(0.3674)
	Atlantic Spadefish	35.06	(48.4)	0.5285	(1.0397)
	Least Puffer	29.91	(48.3)	0.2359	(0.4420)
	Pinfish	26.55	(87.6)	1.0087	(3.4625)
	Gulf Butterfish	18.34	(33.1)	0.0504	(0.0916)
	Red Drum	18.12	(95.7)	0.0030	(0.0138)
	Spotted Seatrout	16.48	(81.0)	0.4056	(2.0265)
	Star Drum	16.45	(35.7)	0.0985	(0.2090)
	Seabob	12.94	(44.4)	0.0268	(0.0983)
	Parasitic Isopod	12.63	(17.7)	0.0022	(0.0033)
	Threadfin Shad	12.56	(31.6)	0.1837	(0.4665)
	Atlantic Midshipman	10.32	(21.3)	0.0426	(0.1030)
	Blackcheek Tonguefish	9.89	(27.3)	0.0649	(0.1613)
	Pigfish	8.06	(30.6)	0.8593	(3.0270)
	Iridescent Swimming Crab	7.62	(20.4)	0.0262	(0.0604)
	Striped Mullet	7.28	(21.0)	0.4316	(0.6883)
	Cutlassfish	7.14	(9.5)	0.1435	(0.2835)
	Lined Sole	6.77	(21.6)	0.0222	(0.0736)
	Southern Kingfish	4.46	(8.3)	0.1843	(0.6502)
	Harvestfish	4.34	(14.2)	0.1066	(0.3805)
	Atlantic Bumper	4.32	(18.3)	0.0152	(0.0671)
	Lookdown	4.15	(7.9)	0.0287	(0.0554)
	White Mullet	3.81	(15.4)	0.0890	(0.3332)
	Pink Shrimp	3.49	(6.7)	0.0163	(0.0316)
	Banded Drum	3.20	(7.5)	0.0090	(0.0226)
	Black Drum	1.92	(7.5)	0.3491	(1.1767)
	Atlantic Stingray	1.83	(4.6)	0.6293	(1.9768)
	Highfin Goby	1.52	(3.8)	0.0110	(0.0285)
	Spotfin Mojarra	1.33	(4.8)	0.0122	(0.0441)
	Sheephead	1.15	(6.0)	0.1253	(0.5037)
	Striped Anchovy	1.10	(5.1)	0.0109	(0.0482)
	Bluntnose Jack	1.06	(2.6)	0.0031	(0.0109)
	Hogchoker	1.02	(3.0)	0.0062	(0.0180)